THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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RAILWAY ELECTRIFICATION COSTS.

THE application of electric traction to the suburban lines of the London, Brighton and South Coast Railway was and still remains the only important example of single-phase electrification in this country; it has been the focus of discussion on many occasions, when engineers were eager to see the details of receipts and expenses in connection with its operation, but these were not disclosed. In his valuable paper read before the Institute of Transport recently, Sir Philip Dawson, who was responsible for the choice of alternating current in 1904, and for the development and extension of the electrification in subsequent years, made public a mass of information and data on the subject which should prove exceedingly useful. On the basis of his figures, which, he states, are the outcome of a minute and extended investigation with a view to further conversion, the case for electrification is overwhelming; moreover, up to the present only suburban lines have been converted to electrical operation, and the results obtained when the main line to the coast is electrified should be still more satisfactory, having in view the more remunerative traffic and the absence of competition from tramways and omnibuses.

The matter is of far more than local importance, for it concerns the future of railway electrification and of our affected industries very nearly. The Institute of Transport has laid down certain guiding principles for British railways, definitely favouring direct current, but specifically exempting the "Brighton" railway from interference. Our manufacturers will have opportunities in the future of tendering for railway electrification abroad to specifications requiring the adoption of the single-phase system, and if we could not show a single large-scale example of that system at home our position would be prejudiced in competition with outside firms; we should have no suitable facilities for testing new single-phase apparatus, and we should not be able to compare the merits of a.c. and d.c. systems from actual experience.

If, therefore, for no other reason than the foregoing, it is important that a great single-phase railway should be in successful operation in this country. But there are other reasons also for congratulating ourselves (and Sir Philip and his directors) on the success of this undertaking. It has been pointed out by Mr. George Gibbs, consulting engineer to the Pennsylvania Railroad, who has exhaustively studied the subject, that the choice of system is not of fundamental importance; electrification on either a.c. or d.c. lines has proved its merits, and to that extent is independent of the actual system adopted—but a big success is preferable to a moderate one, and we are by no means convinced that the Ministry of Transport has permanently settled the matter. For long-distance work, Mr. Gibbs states that the single-phase system at 11,000 volts is the most advantageous system yet devised. We look forward to the ultimate adoption of single-phase supply to the trains and the use of direct-current motors for propulsion, and when the electrification of our main lines is seriously taken in hand, we hope that the designs will be prepared without prejudice in favour of either system, but with an absolutely unbiased mind and a full appreciation not only of the existing situation, but also of the trend of invention and development. The conversion of steam railways to electrical operation is one of the biggest openings for British manufacturers, and it is impossible to devote too much attention to the examination of the question from every point of view.

GERMAN INDUSTRIES IN 1922.

The Department of Overseas Trade has issued a report on the economic and financial conditions in Germany down to March, 1923, which has been prepared by Mr. J. W. F. Thelwall, commercial secretary to His Majesty's Embassy in Berlin, assisted by Mr. C. J. Kavanagh, commercial secretary in the occupied territories at Cologne.

Apart from the financial section, the report, as in the case of its immediate predecessors, affords a fresh proof of the continued policy of German State and industrial interests in allowing an abundance of information to become public property on matters which throw no real light on the actual situation of various important industries, while at the same time withholding facts respecting vital questions in other directions. Under these circumstances we find in the report a lot of statistics concerning the foreign trade of the country for most of last year, and of the coal industry, together with information relating to the iron and steel industry and allied trades and to labour and the cost of living. On the other hand, there is an absence of information respecting the developments in the shipping industry in 1922, of the shipbuilding industry, and of the electrical manufacturing, the textile and the chemical industries.

Taking first into consideration one part of the financial section of the report, it is stated to be necessary to exercise extreme caution in expressing any opinion as to Germany's real position at the end of last year. As to the bank balances held abroad, partly due to gold earnings which do not enter the country, it is considered that these are of importance because of the part which they may play in the future development when the Germans feel at liberty freely to use them in connection with the natural and industrial resources of the country.

As compared with the year 1913, when Germany had a considerable balance of coal exports over imports, the situation has become reversed in the sense that as a consequence of the coal reparation deliveries last year, the country has become a larger importer of coal and now has a surplus of imports over exports. In this direction the report points out that English coal, which ten years ago as a rule only reached the coastal towns of Germany, at present finds its way to internal centres of consumption. Of course, an entirely new situation has been created by the occupation of the Ruhr, although it has to be noted that most of the coal production in that region is consumed locally, only about 43 per cent. of the Ruhr output under normal conditions being forwarded to those parts of the country which are not in foreign occupation at the present time. But with the comparative shortage of pit coal last year, a further impetus was given to the production of lignite which in quantity exceeded the output of pit coal for the first time in the existence of the country, and this inferior fuel enjoys increasing favour for all kinds of industrial purposes.

The report, referring to iron and steel, mentions that the industry was operated at full pressure last year; the majority of the blast furnaces were in use, the steel works were well occupied, the engineering trades even suffered from a scarcity of raw materials, and the workpeople were fully employed. This state of affairs is ascribed to one thing—inflation. The destruction of confidence in the mark led to an enormous demand for commodities. It is this demand for goods, the report says, whether on the part of consumers of pocket knives or by industrialists anxious to convert profits and reserves into plant of an intrinsic gold value, and the consequential abnormal scale upon which replacements have been carried out, to which it is necessary to turn for an explanation of the activity of the steel industry. Inland activity, it is stated, was feverish and, although a certain volume of the production was speculatively hoarded in the form of goods, a large part of it was concentrated in the rebuilding of factories, new buildings, extensions, the erection of electricity works, in shipping, State and private railway construction work and in public works. The funds derived from the Government for the liquidation of the iron and steel works in ceded territories have been utilised to build new plant; and the reconstruction under State compensation of the forfeited merchant fleet has been energetically taken in hand, while much development has centred around the conversion of armament plant to peace requirements. In a word, German industry to-day is found to be most efficiently equipped.

The production of pig iron last year is estimated at nearly nine millions of tons, and that of steel is put at about the same figure. The present loss of competitive power of the German steel industry in the world's markets, owing to the strong home demand and the increases in the costs of production, is considered to be a passing phase; but, generally speaking, the report states that Germany still retains large advantages in labour, fuel and transport costs, while the syndication of the works in the form of groups ensures a cheap supply of raw materials to the works producing the more highly finished products. In this connection it may be mentioned that although Germany was compelled to import last year a large quantity of pig iron, scrap and semi-finished steel and her total imports amounted to 2,500,000 tons, her exports of iron and steel were higher at 2,654,000 tons.

A word may be said in conclusion concerning the extension of industrial interests last year in the direction of amalgamations, participations, and the establishment of communities of interests. The operations in these respects were not so large as in the immediately preceding years, but they were sufficiently important to show the continuation of the work of concentration and of interconnection of interests which complement each other and the further association together of works representing other and higher stages of manufacturing. The steps in these directions are set forth in the report, which also contains as an appendix a valuable table indicating the ramifications of the big groups of the leading coal, iron and steel and engineering works in the country at the present time.

Natural "Laws."

As knowledge accumulates and phenomena are classified, a stage at last is reached in any branch of science at which it becomes possible to formulate a general statement embodying the principles which have been established, and this is usually described as a "law." There is a tendency, fostered by the use of this term, to regard such a statement as final and as incorporating the whole truth with regard to the particular sequence of phenomena that is under consideration, but any student of science is or should be aware that that is not necessarily or even probably the case; the so-called "law" represents the facts so far as we know them, but is always liable to be modified in the light of greater knowledge. Noteworthy examples of such amendment are to be found in connection with Dalton's atomic theory—science has shown that there is an immense field for research within the atom which Dalton regarded as the ultimate particle of matter—and with Newton's law of gravitation, which Lorentz, Einstein, and other physicists are subjecting to a critical examination to-day. So also the accepted theory with regard to the nature of electricity has been found to be but a rough approximation to the truth; and in the field of electromagnetism there are many problems awaiting solution.

In recent issues we have given a brief abstract of a very long paper by Mr. Carl Hering, in which he questions the validity and completeness of certain "laws" which have held sway for many years. As the discoverer of the "pinch" effect and other electromagnetic phenomena, Mr. Hering has established his right to the respectful consideration of his views; and the mere fact that certain propositions have up to the present been accepted as "laws" ought not to hinder us in the least from discussing their accuracy. Our ignorance of the

cause and nature of magnetism is profound—we are still in the region of speculation and hypothesis; and there is no reason to doubt that research in this field will ultimately be as fruitful as it has already proved to be in that of electrostatics.

Electrical Promise Abroad.

Further grounds for optimism regarding the outlook for British electrical export trade are to be found in the statements made by authorities who have lately returned from business visits to the East and the Far East. The situation in India is well worth noting. As reported in our issue of May 4th (p. 703), the export manager of one company (the English Electric) had come back from a five months' visit to that country full of confidence in the revival of trade and in the rapid growth of the demand for electrical manufactures throughout the Indian Empire. Sir Thomas Callender, managing director of Callender's Cable and Construction Co., Ltd. (than whom by the way there is, we suppose, no more extensively-travelled electro-industrial leader amongst us) has lately added another to his numerous visits to India, where his company has carried out substantial contracts. At the meeting of the company held last week, and reported on another page of this issue, Sir Thomas compared the state of Indian affairs now with that which obtained when he was there about two years ago. Whereas in 1921 the country was seething with discontent and the "non-co-operative" spirit, there is now a much better feeling and a desire to open up business and carry on work in which we and they are mutually interested. Sir Thomas has strengthened the company's Indian connections and opened up the way for extended operations in a market which is already proving a good source of revenue. Sir Fortescue Flannery, in alluding to the Callender operations in the Far East, made mention of their "adventure" in China, which he said they had every reason to believe would bring satisfactory business to their factories here. As we have so frequently discussed Chinese affairs in these pages and urged our manufacturers to take the long view in regard to this vast though unsettled market, it is interesting to note that Sir Thomas has not taken hurried steps there as great things are not to be expected from China for a few years. The operations of the next year or two will consist of laying the foundations for large business later, and this involves outlay which cannot be revenue-producing immediately. The company has been represented in the country during the past year collecting information—the vastness and variety in China take some studying!—and a Callender office has now been opened in Shanghai.

Last week we illustrated up-to-date activities of the General Electric Co.'s Branch at Hankow by means of an electric houseboat which is demonstrating G.E.C. products at various towns on the Han River. The company began its operations in China some years before the war.

Another statement which is reported in our "City Notes" also bears on the Eastern and Far Eastern markets. Mr. John Macgregor, the managing director of Johnson & Phillips, Ltd., states that for the past two years there has been strong evidence of the growing demand in these markets for British manufactures. He added that only the political and financial position had kept back the huge orders which must ultimately come to this country.

There never has been, in our minds, justification for anything other than great hope regarding the future of British electrical industry. Before the war the whole world gave signs of a great electrical awakening or appreciation; the conflagration put the brake on development and delayed its pace, indeed for a time brought it to a standstill, but it could not prevent the inevitable. Now as sign after sign appears of a world effort and tendency to return to normal development, recourse will be had to electricity everywhere. The return, both at home and abroad, may not be a hurried one, but beyond a shadow of doubt it is coming. The hydro-electric and railway schemes of India, similar operations in New Zealand and South America, and electrical activity in South Africa, are the movement among the "dry bones," and before long, we dare hope, even in Russia, there will be great contributions to electrical advance; indeed throughout practically all those parts of the world where British engineers are justified in looking for new business, the situation, considered from the standpoint of electrical possibility, may be summed up in Cecil Rhodes's unforgettable words regarding his life-work in Africa: "So little done—so much remains to do!"

The Institution of Engineers (India).

The arrival of Vol. III of the *Journal* of the Institution of Engineers (India) prompts us to congratulate the promoters of this society on the excellent progress that it has made since its incorporation three years ago. Its strength and influence are constantly increasing, and the difficulties which it has met with are being steadily overcome, whilst the quality of the papers included in the volume before us indicates that its technical standing is in no way inferior to that of other engineering institutions. It is interesting to observe that four of these five papers bear more or less directly on electrical engineering, and two of them are essentially electrical—one which describes the new power station of the Andhra Valley Electric Power Co., which is approaching completion, and one on railway electrification, with special reference to Indian conditions, a subject of the first importance to British manufacturers.

Another paper, by Mr. D. G. Harris, deals with the magnificent irrigation projects which have been and are being carried out in India, with immense advantage to the population, making the desert blossom like a rose; when the present work is completed, a total area of 40 million acres will be irrigated, forming a perpetual monument to the beneficent operations of the engineers of the Indian Government.

The Royal Society Soirée.

Whilst there was no very remarkable novelty at the annual conversazione of the Royal Society last week, there was one feature common to a large proportion of the exhibits which almost forced itself upon one's notice—the widespread use of electricity as a means of, or an aid to, measurement. Physicists, biologists, agriculturists, microscopists—it would seem that sooner or later all scientific workers are indebted to electricity for the solution of their difficulties, and when they have once experienced the delights of electrical methods they are lifelong adherents to them. A vast amount of ingenuity is expended on the development of electrical devices for such purposes, and not infrequently the result is the evolution of an instrument which is of value to a far wider circle than that for which it was originally produced. Moreover, by electrical means degrees of accuracy are attained which were previously undreamt of, and a convenience of manipulation is secured which effects a great economy of time. A notable instance of the last-named quality was furnished by an automatic electric balance devised by Prof. Oden and Dr. B. A. Keen, of the Rothamsted Experimental Station, for recording continuously the accumulating weight of deposit from soil suspended in water, which accomplishes by mechanism what was formerly a tedious and expensive task; and an example of refined accuracy was seen in a chronograph controlled by a tuning fork maintained in oscillation by a three-electrode valve, the instrument giving a graphic record which could be read to the ten-thousandth part of a second over any desired period of time. An interesting application of the Johnsen-Rahbek electrostatic stress to the testing of lubricating oils shows how quickly a newly-discovered electrical phenomenon is turned to practical use in quite unexpected directions.

D

THE DESIGN OF CURRENT TRANSFORMERS.

By G. L. E. METZ.

When designing current transformers for use on electrical circuits it is possible to start from quite a number of different standpoints, each of which will eventually result in a satisfactory design, but the amount of checking and refining that each method of attack entails varies in every case. In common with all design work, the first few transformers built have to be most carefully checked over as far as is possible until a certain amount of reliable data is obtained, and it is this information that lays the foundation for future designs.

Before this article was written, a number of careful investigations and tests were made, and the results are given hereunder with the hope that they may prove a help and guide to those who are actually designing current transformers, and have not the great advantage of past records on which to work.

The majority of problems met with in this subject are based fundamentally on the fact that when load is put on a current transformer, its current remains constant for all practical purposes but the voltage it generates, and therefore its flux, increases; with potential transformers the converse appears—the increase of load entails an increase of current and the voltage remains constant.

Naturally enough, when the current transformer is unloaded, no trouble is experienced; it is when the apparatus is loaded that the troubles begin to appear.

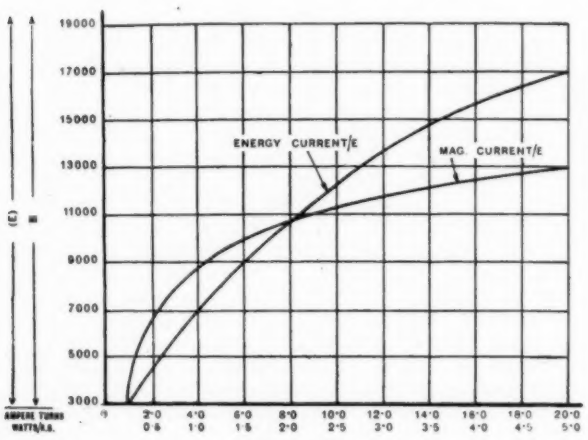

Fig. 1.

We have seen that increased load means increased voltage at the secondary terminals, and the voltage is connected with the flux by the well-known formula:—

$$E = 4.44\ T f \phi \div 10^8 \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad 1.$$

Therefore we have increased flux (ϕ), and, as the core is of constant cross section, this results in increased flux density B.

Recalling the well-known B/AT curve, it will be remembered that an increase of flux density B entails an increase of ampere-turns necessary to drive this flux round the iron circuit, and as B is proportional to the secondary voltage E which constitutes the load, we can plot E instead of B against the ampere-turns A T (fig. 1). We then have a curve similar in shape to the B/H curve, but giving us the secondary load as a function of the ampere-turns necessary to force the required flux round the magnetic circuit. Remembering how the B/H curve falls off as the value of B increases beyond a certain amount, it will follow that when a certain load is reached the ampere-turns increase considerably for a slight increase of load. Let us consider what this means: the turns on a transformer are constant, and any increase in the number of ampere-turns required for doing internal work (seeing that the turns do not increase) demands an increase in current.

Then, if the amperes used in doing internal work in a transformer are high, fewer amperes are available for the external circuit, and the load current will correspondingly decrease.

There is yet a further amount of internal work to be done; this is the core loss. Now, the curve showing the core loss as a function of the flux density is similar in shape to the B/H curve, and has the peculiarity described above that after a certain secondary load has been reached, any further increase will involve a serious increase in the core loss watts, which in turn necessitates the use of more amperes in doing internal work and leaves still less current available for doing useful work externally.

It is obvious that one cannot use the current for internal work and use it again in an external circuit; the result is that unless great care is used in design, the secondary amperes fall away when load is put on and the current transformer does not transform according to its true ratio of turns.

It is not difficult to imagine exactly how the secondary current falls away from the true turn ratio, which is a straight-line curve; the actual ratio leaves the straight-

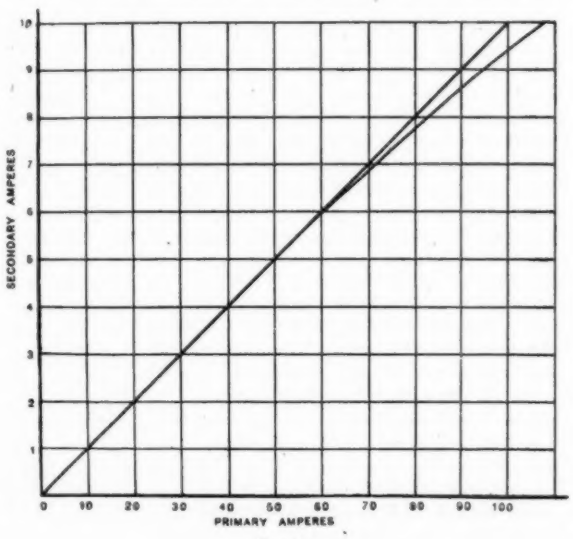

Fig. 2.

line characteristic at full load and falls just below it (fig. 2).

Although good regulation is required in a potential transformer, it is of even greater importance with a current transformer, more especially if it is built to operate an integrating meter, where even the slightest mistake due to bad regulation would integrate up to a very substantial amount. It is evident, therefore, that too much time and trouble cannot be spent in trying to eliminate the factors conducive to bad regulation.

A little further consideration will show that this falling-off of ratio, or ratio error, is not the only error which has to be contended with, and perhaps a vector diagram will illustrate this fact as well as anything.

The vector diagram is given in fig. 3, a turns ratio of unity being taken for the sake of simplicity.

Starting with the flux vector ϕ, the primary and secondary voltages Ep and Es will each be at right angles to ϕ, being in mutual opposition. The secondary current Is will lag behind Es by an angle A depending upon the impedance of the secondary circuit; this secondary current will be balanced by a component I_{s_1} of the primary current. To generate the flux ϕ, a small exciting current will be required, Io, and due to core loss this component will slightly lead the flux vector.

The total primary current Ip will be the vector sum of Is and Io; from the figure it can be seen that the vector Ip is greater in magnitude than the vector Is, due to the internal losses. Again, Ip and Is are not exactly in phase opposition, and the small angle separating them, α, is known as the phase angle of the transformer.

From the foregoing we see that the two failings of current transformers are—

(1) *Ratio Error.*—This is the percentage difference between Is and Ip, multiplied by the turn ratio.

(2) *Phase Angle Error.*—The angle α mentioned above.

The study of this vector diagram shows quite plainly that these two errors depend not only on the magnitudes of the exciting and core-loss currents, but also upon their proportions. The actual phase relation of these two currents follows the lines that would be expected:—

Im, the current necessary to drive the flux round the iron

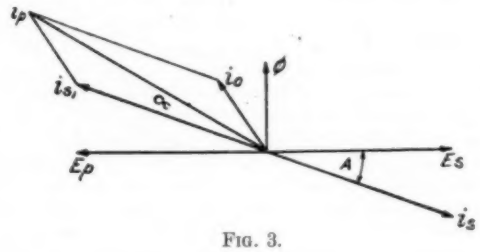

Fig. 3.

circuit, is in phase with the flux ϕ, and Ie, the current due to core loss, in phase with the e.m.f. vector E (fig. 4). Any increase in Im will be conducive to phase-angle error; any increase in Ie will be conducive to ratio error. We must therefore compromise between the two.

For a constant secondary load, the flux necessary to generate the requisite secondary voltage will vary inversely as the number of turns, and the flux density, of course, will vary with the cross-section of the magnetic circuit.

The flux density will require a certain exciting current to maintain it, and this current will vary directly as the length of core and inversely as the number of primary turns. It can be seen, therefore, that for a given secondary voltage or load, if the exciting current is to be small, then the number of turns, cross-section of iron core, and permeability must be high, whilst the magnetic circuit should be as short as possible.

Now, if the number of turns is increased, the length of magnetic circuit must be increased, and a practical limit therefore exists restricting the number of turns to employ. The author has found by experience that good results have been obtained by using 1,000 ampere-turns together with a liberal section of iron core.

Again, the flux density in the iron core should be kept as low as possible, but considerations of proportion put a limit to the cross-section of iron it is economical to use, and it has been found that a value for the density of 800 lines per sq. cm. should give good practical results.

The adoption of the two empirical figures given above as values for number of ampere-turns and flux density now makes the design of the transformer a most simple operation, and the three main dimensions can be obtained straight away by means of the simple formulæ below:—

Number of primary turns $T = 1{,}000/\text{primary current}$.
Total flux $\phi = E \times 10^8/4.44\ T\ f$.
Cross-section of core $= \phi/800$ sq. cm.

It is now only necessary suitably to arrange the windings upon the iron core and thus fix the magnitude of the core length, and the electrical portion of the design is complete.

At this point it is advisable to check up the ratio and phase-angle error in order to make quite sure that they are within the limits given in the British Engineering Standards Association Report No. 81.

The calculations necessary to ascertain these errors involve a certain amount of tedious, though simple, mathematics, which would be out of place if included in this article; bearing in mind the foregoing remarks on the exciting current, it will be remembered that while the magnitude and phase angle of this component are of importance, the power factor of the secondary load also comes into the equation as a variable. So that while the exciting current may be of the same magnitude and direction in two exactly similar transformers, the ratio error will not be the same unless the power factor of the secondary load of each transformer is similar.

A comparison of a number of equations giving the ratio and phase-angle errors for a given load has been made by the author, and, after some investigations, it has been found that the following are of the most general use and simple form:—

Ratio error for inductive load =

$$X \div [(I_S \cos A + I_E) + J\ (I_S \sin A + I_M)]$$

Phase-angle error =

$$A - \tan^{-1} [(I_S \sin A + I_M)/(I_S \cos A + I_E)]$$

Where X = The nominal primary current divided by the turn ratio.
,, Is = Secondary load current.
,, Ie = Iron-loss current.
,, Im = Magnetising current.
,, A = Power factor of secondary load
,, J = $\sqrt{-1}$.

A consideration of the vector diagram No. 3, together with the formulæ above, might suggest that the phase angle error could be eliminated if the phase of the secondary current could be arranged to be exactly opposed to that of the exciting current. This arrangement would have many objections, but further investigations show that it would not be possible, because the phase of the exciting current is not constant, neither

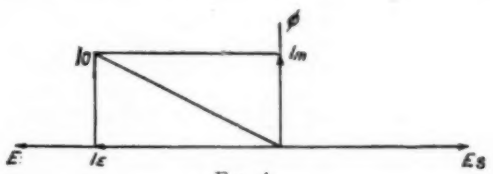

Fig. 4.

is it proportional to the load, its variation being entirely dependent on the saturation curve of the iron of which the transformer is built.

While the electrical side of current transformer design is of primary importance, the mechanical aspect must also receive most careful attention. The maximum possible short-circuit current on systems which normally carry a current of quite a low order is very high, and the modern tendency is such that this short-circuit current is likely to increase; as the mechanical stresses set up by a conductor carrying current vary as the current squared, it can readily be imagined that a careful check must be made on a transformer before completion to ascertain that it is capable of dealing with such a current.

Christiania, a City of Light.—Discussing the question of electricity supply in Christiania before the Norwegian Electrotechnical Association, Mr. Ragnvald Steen is reported to have stated that there are now only two houses in that city where electric lighting is not installed. The development of the supply from the modest steam-generating station of 1,200 h.p., which was started in 1892, has been considerable, with the result that the municipal council now distributes about 40,000 kW. Some 26,000 kW is transmitted from three hydro-electric works or transformer stations at a distance from the town, while the old steam station has been expanded to 14,000 kW. The capital invested by the city in the various electrical works amounted to 101,000,000 kr. at the end of 1922, which sum has been written down to 77,000,000 kr.

THE ROYAL SOCIETY'S SOIRÉE.

The first of the two annual conversaziones held by the Royal Society was attended on the evening of May 16th by a large number of Fellows and guests, who were welcomed by the president, Sir Charles Sherrington, K.B.E., M.D. Many exhibits and demonstrations had been arranged, as usual, for the edification of the visitors, but it must be admitted that they included nothing of a sensational character on this occasion.

During the evening Sir Richard Paget, Bart., demonstrated the nature and reproduction of vowel sounds; Prof. Wheatstone's talking machine, 1834-37 (from the Wheatstone collection at King's College) was shown in operation, and a set of plasticine models was exhibited, each reproducing one of the English vowel sounds, as well as an adjustable model by means of which any of the vowel sounds could be produced. The action of the devices depends on the blowing of air past a vibrating reed, attached to which is a double resonator that is tuned so as to reproduce the two principal resonances heard in the human mouth when the vowel is breathed or whispered.

The kinematograph exhibition of Mr. Walter Heape, F.R.S., included a series of films taken at rates of from 2,000 to 3,000 per second by means of a rapid kinema machine. One set of photographs showed what happens when a 15-in. Osram electric lamp bulb is broken with a hammer, and another recorded the contortions of a solid rubber ball when shot from a gun against a steel target, that is, during a flight of about 1/40 second.

The Anglo-Persian Oil Co., Ltd., showed lubricating oils under electrostatic stress applied by means of a disk of brass resting on the smooth surface of a piece of lithographic or printer's stone. The disk is connected to a negative source of electricity at a pressure of 105 volts whilst the stone is connected by means of the copper plate on which it rests to the opposite pole. Under these conditions, it can be shown by a balance system of suspension that the electrostatic stress is capable of supporting a considerable weight. If the surface of the stone is covered with a thin film of lubricating oil, and the potential difference applied as indicated above, a decrease in the electrostatic pull is observed; this pull varies with different oils.

Professors J. T. MacGregor-Morris and E. Mallett showed sand figures of the numerous resonant modes of vibration of telephone-receiver diaphragms, the method of obtaining them being to excite a telephone receiver whose diaphragm is arranged in a horizontal plane with alternating current supplied by a thermionic valve oscillator. Sand is sprinkled on the diaphragm and, as the frequency of the a.c. is progressively raised, the various modes of mechanical resonance appear with great sharpness (Chladni's figures). At least seven modes of vibration are shown within the limits of audition, and their frequencies have been compared with those obtained from both the membrane and the plate theories, a graph of the results obtained being exhibited.

Amongst the exhibits of the National Physical Laboratory were X-ray spectrographic curves (Dr. E. A. Owen and Mr. G. D. Preston), showing the atomic structure of pure metals and alloys. Sir William Bragg, F.R.S., had models of the structure of tartaric and racemic acid (Mr. W. T. Astbury), and others illustrating the arrangement of the molecules in basic beryllium acetate, on view. Mr. E. E. Brooks's photographs of the lines of electric force, which it will be remembered were recently thrown on the lantern screen at the I.E.E., were taken in 1913, 1919, and 1923 primarily for teaching purposes, but are likely to prove of value to cable makers and others in the electrical world. They were obtained by means of certain aniline dyes suspended in a dielectric liquid, such as turpentine, which are found to give a very fair map of the electric field.

The display of the International Western Electric Co., Ltd., was in three sections: namely (i) a water-cooled thermionic valve of the same type as those used in the transatlantic radio-telephony test at the beginning of the year; a special feature of the tube is the copper-glass joint, and some parts showing the construction of the tube were also exhibited, in addition to photographs of 100-kW and 10-kW valves and curves indicating the relation between transatlantic signal strength and interference. (ii) A low-voltage kathode-ray oscillograph that members of the I.E.E. had an opportunity of seeing some time ago, which consists of a glass tube in which a kathode ray is generated between a hot filament kathode and a small tubular anode. The ray is rendered visible by striking a fluorescent screen at the end of the tube, and is deflected with the help of two pairs of parallel plates set at right angles between which the ray passes. To the two pairs of plates two alternating potentials are applied: the fluorescent spot then traces out a curve which is a graph of the relation between the two potentials. (iii) Rochelle salt piezo-electric crystals, one of which was suitably mounted as a gramophone transmitter. The vibrations on the records are transmitted through the needle and cause deformations of the crystals, which produce corresponding alternating differences of potential which, when applied to a telephone receiver, will reproduce the music very faithfully. The crystal is said to be reversible and can be used as a "loud-speaking" receiver. If alternating differences of potential are applied to the crystal, the corresponding deformations can be made to cause air vibrations by suitably fitting a paper cone to it.

The Cambridge and Paul Instrument Co., Ltd., demonstrated a method of running a d.c. motor under a variable load, or on a variable voltage, in synchronism with a tuning fork. A phonic motor, designed by Dr. A. B. Wood, driven by a tuning fork, moves a contact on a circular rheostat, which is rotated by the motor which it is wished to control. If the latter gains or loses speed relatively to the phonic motor, the rheostat is adjusted automatically to correct the speed of the motor. The mechanism exhibited formed the driving part of a plotting chronograph designed by Dr. W. Rosenhain, F.R.S., and was exhibited by the courtesy of the director of the National Physical Laboratory.

The National Institute of Industrial Psychology (Dr. C. S. Myers, F.R.S.) showed examples of research work, including investigations in a coal mine (Mr. Eric Farmer), on illumination. Charts showed the 15 per cent. increase in output obtained by improved illumination, and the striking reduction in the number and duration of the disturbing after-images (recorded by miners), after "frosting" the miner's standard electric lamp. Lamps of the ordinary and frosted types were exhibited in a dark chamber for comparison. The miners are practically unanimous in their demand for the frosted lamp: they claim that it affords better vision and less eye-strain.

The exhibit of the Physical Department of the Rothamsted Experimental Station, Harpenden (Dr. B. A. Keen with Messrs. E. M. Crowther and W. B. Haines) was intended to demonstrate the great importance of flocculation and deflocculation in soils. The automatic electrically-controlled recording balance (an improved form of the example seen at the last Physical Society exhibition), devised by Prof. Oden and Dr. Keen, furnishes a continuous time record of the accumulating weight of deposit from a soil suspension, and analysis of the time-weight curve thus obtained enables a distribution curve to be drawn.

Mr. F. Harrison Glew exhibited what he termed a "levitating" magnet, the experiment showing a bar magnet of cobalt steel floating by repulsion above the opposed poles of a fixed magnet at a vertical distance of half-an-inch, or more, according to the strength of the magnetic field. The floating magnet is free to move

vertically and may be made to oscillate up and down in its glass enclosure. The experiment fails with ordinary magnet steel on account of the reversal of polarity that takes place in the intense magnetic field necessary for flotation.

The National Institute for Medical Research (Dr. E. H. J. Schuster) showed a new recording kata-thermometer—an instrument for measuring the cooling power of air. In its original form it consisted of a large-bulbed spirit thermometer heated in hot water to 100 deg. F. and then allowed to cool to 95 deg. F. The time of cooling was noted by means of a stop-watch, and formed the measure of the cooling power, in that the lower is the cooling power the less time the instrument takes to cool. In the apparatus exhibited, the heating was done automatically by electricity after each cooling period, and the length of time of each cooling period was automatically recorded as a line traced on a roll of paper.

The Research Department, Woolwich, demonstrated the detection of feeble X-ray beams by smoke clouds. In this method a smoke cloud, having a flat top, is produced in a small chamber, and above the cloud is placed an electrode maintained at a potential of about 400 volts above earth. The cloud is then interposed in the path of an X-ray beam, and some of the ions thus produced attach themselves to the smoke particles, which are then drawn up from the top of the cloud under the influence of the electrostatic field. The movement of these particles is observed by an ultra-microscope. The exhibit illustrated the application of the method to the detection of feeble X-ray beams reflected from crystals.

Another device was a chronograph for use with a photographic recorder. It has been designed for use with a multiple string Einthoven galvanometer, and time intervals of 1/1,000th second are recorded on a moving kinematograph record (paper or film) by interrupting the light of the galvanometer lantern by means of a wheel with 20 radial vanes, which is made to revolve at 50 revolutions per second. This vane wheel is mounted on the shaft of a small a.c. motor, designed to run synchronously at a frequency of 1,000 cycles from an oscillating electrical circuit, the frequency of which is controlled by a 1,000-cycle tuning fork, maintained in oscillation by a three-electrode valve. The synchronous motor was shown to keep time with the supply current, and the accuracy of the recorder for long or short time intervals is at least 1/10,000th second.

Mr. S. G. Brown, F.R.S., had the "Frenophone" on view. It is a novel form of loud-speaking telephone, in which the sound is produced from a receiver of the usual type whose action is amplified by means of friction. The telephonic current controls the pressure of a small rubbing pad upon a revolving glass disk; and the variations in the resulting frictional drag are applied to the telephone diaphragm of the instrument, which was exhibited working from a radio-telephone receiving set.

Finally, the Natural History Section of the Department of Zoology of the British Museum (Messrs. C. Tate Regan, F.R.S., and M. A. C. Hinton) showed deep-sea cables damaged by shark's bites, the teeth having penetrated between the coils of the wire armouring and been broken off short. The samples of cable exhibited were (i) from South-west Africa, 250 fathoms, with tooth of *Lamna spallanzanii;* and (ii) from the Indian Ocean, 750 fathoms, with tooth of *Scapanorhynchus*, the last-named being a deep-water shark that may have been feeding on animals growing on the cable, some of which were also exhibited.

ELECTRO-FARMING.—V.

The Electric Lighting of Farm Buildings.

By R. BORLASE MATTHEWS, Wh. Ex., A.M.Inst.C.E., M.I.E.E., F.R.Ae.S.

Economics.—Reference has already been made to the wonderful increase in egg production (10 to 25 per cent. more eggs per bird, according to the breed, in the winter season) due to the use of electric light on poultry farms and in the poultry department of general farms (Electrical Review, Vol. 91, December 1st, 1922.) In the present notes it is, however, proposed to deal with electric light merely as a lighting medium.

The only alternative to electric light on a farm is the oil lamp. Petrol gas and acetylene gas have been tried, but have been found to be too dangerous and too troublesome. As it is, the oil lamp itself is bad enough, as regards chances of fire. Thus the farmer's problem is simplified down to a choice between only two forms of light: the one, now an old institution of precedent, that is dangerous, and whose total cost for labour in filling, trimming, &c., plus oil, is very high for candle-power obtained; and the other, whose only objection is the bigger initial outlay, to obtain a light which is cheaper in the end and absolutely safe. Notwithstanding all its advantages, the great majority of farmers have not got the slightest idea as to how to set about obtaining electric light; and, in fact, are rather inclined to regard it merely as a luxury for the house of the country gentleman.

When the writer first installed electric light in his cow byres, he did so to eliminate the risk of fire, due to the cows kicking over the hurricane lamps usually employed. He has, however, since made the pleasing discovery that the value of the milk *not spilled*—thanks to good lighting—far more than compensates for the cost of the electric current. There are also a number of other savings, not easily calculated, which are due to the fact that men working in a good light can do much better work, and especially in milk production, more cleanly work.

It is frequently stated, and to an electrical engineer the fact seems quite obvious, that the use of electric light by a farmer results in considerable economy. However, it is very difficult to get such a general statement down to the exact detail of specific instances.

With a view to getting some data as a basis to work upon, an interesting experiment, which sheds some light on the subject, was carried out recently by the Agricultural Engineering Department of the University of Wisconsin. This experiment consisted of getting a reliable man, a working farm foreman, to do usual routine work, by oil lamp one night and by electric light the next. The man who did this work had had many years' experience of the same routine work, hence it might be safely stated that the work was carried out subconsciously, in a mechanical way. At the same time he was accustomed to the occasional thirst of his employers for data. Hence no slight departure from the usual routine would be liable to disturb the even tenor of his work. Again, he was accustomed to working both with oil lamps and electric light. Hence, as far as could be arranged in such a crude experiment, the conditions were as favourable for the one case as for the other. The results of the experiment are given in the table on p. 808.

Wiring.—This is usually looked upon as a simple problem—by those who don't know. It may seem absurd, but the conditions that a farm electric wiring system have to work under would severely test the electric wiring installation in a chemical factory. The chief troubles are due to ammonia and also to acid fumes and liquors.

Comparative Times Required to do Work with Oil Lamps and Electric Light.

Operation.	Minutes to carry out operation. Oil lamps.	Electric light.
Stabling cows	4	3
Cleaning mangers	9.50	7
Weighing and feeding grain	31.75	12
Feeding silage and hay ...	39.25	33
	84.50	55

Difference in favour of electric light, 29.5 minutes.
Percentage saving of time, 34.9 per cent.

It is not generally known that inflammable gases are given off by a decomposing manure. Accompanying the fumes is usually a warm, damp atmosphere, which does not tend to improve matters. Innumerable flies leave their marks and effects on the protective material of exposed wiring. The farm live stock, especially horses, pull down everything within reach, and soon learn to turn on electric light switches, and so waste light. Again, farming is an old industry, and parts of most farm buildings seem to be nearly as old as the industry. On the Continent a number of electrical contractors have solved the difficult problem of cow byre wiring, by running bare wires close to the ceiling on petticoat insulators, similar to those used for telephone work. The rotary switches are also mounted on the ceiling, and operated by pendant turn-rods. Of course, steel conduit is a hopeless proposition. Even the modern graded lead-covered wire is far from satisfactory, owing to the corrosion that arises, due to the formation of lead salts. Toughened rubber-covered (or cab-tire sheathed) cable, and in particular the special modification known as "Maconite," from the author's experience, seems to be the only practical type of wiring to use.

(To be continued.)

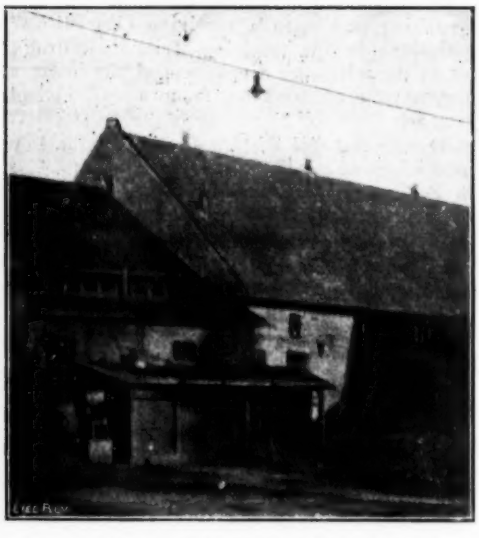

Fig. 1.—Farmyard Lighted by Suspended Lamp.

Fig. 2.—Lighting of a Hen-house.

THE DRIVE OF POWER STATION AUXILIARIES.

Discussion at Liverpool.

The paper on the above subject by Messrs. L. Breach and H. Midgley (an abstract of which was published in our issue of May 4th) was read at the Mersey and North Wales (Liverpool) Centre of the Institution of Electrical Engineers on April 16th, and in the course of the subsequent discussion Mr. P. J. Robinson constructively criticised the paper, remarking that the authors had largely confined their schemes to work in conjunction with a riverside station. He was personally most interested at the moment in the cooling-tower proposition, and he agreed that it was essential money should not be spared to ensure against a possible breakdown of the auxiliaries. The recent proposal to place a d.c. or a.c. generator on the shaft of the main turbine had much to commend it, the only question was whether it was practical. He regretted that the authors considered the most reliable piece of machinery which had hitherto been produced outside the scope of the paper—namely, the ejector, which appeared, from a generating point of view, to be one of the few pieces of plant that could be relied on under almost any conditions, however bad, that might happen; it was also very efficient when properly installed.

The use of two circulating, two air, and two extraction pumps might be desirable, but was not necessarily essential if the pumps were to be installed in a stand-by sense. The electrically-driven feed-pump was not as satisfactory in practice as the turbo-driven feed-pump, and, personally, he would prefer two steam-driven turbo pumps to one steam and one electrical.

With regard to the general drive of the auxiliaries (this applied probably more to a cooling tower than a riverside station) it seemed highly undesirable that they should be driven entirely by a.c., as any diminution in the pressure with a corresponding drop in speed immediately set up a vicious circle through the slowing of the auxiliaries.

The authors' suggested ring-connected switchboard on the h.p. side of the auxiliary supply was an unnecessary complication with little or no advantages. A preferable method would be to take the feed for the auxiliary transformers from between two link switches on the h.p. bars, putting two link switches together in the place of one, or by using throw-over isolating switches to enable this to be done, which would enable the different boards to be cut off for examination and cleaning.

Mr. J. Hamilton did not know of any system for which the claim of absolute reliability might be substantiated; the nearest approach to this condition was reached when a stand-by battery was installed capable of supplying (for a period of, say, one hour) the total power required by the auxiliaries.

All reasonable care should be exercised to ensure continuity of supply, but to say that this should be striven for regardless of expense was placing it upon too high a plane. The relative advantages of a.c. and d.c. drives were worth consideration for chain-grate stokers, as there were times when it might be desirable to accelerate the speed beyond the range usually supplied. The use of a special generator on the main set was attractive from the operating point of view, but the decision largely rested with designers and manufacturers.

Scheme 6 appeared to contain the best features and to be preferable to scheme 7, provided the battery was of a sufficient capacity to drive the d.c. auxiliaries for one hour; it would be cheaper than scheme 7 in capital and operating costs, and quite as reliable.

Mr. A. E. Malpas said it was necessary that all the important links in the chain should be in duplicate. In the case of the smaller-sized units it was more usual, perhaps, to regard the circulating, air, and lift pumps as part of the main unit, and in the event of any accident to any one of the separate items, to shut down that unit as a whole and start up a spare set. With larger units of, say, 10,000 kW capacity, it would no doubt be better to duplicate even the separate auxiliaries of that unit. He agreed with the authors placing reliability first, as on that item the cost of production and the success or otherwise of the station very largely depended. With reference to the power taken by circulating pumps, he pointed out that turbulent flow was obtained when the linear velocity of the water through the tubes was about 6 or 7 ft. per second. Such a high velocity meant rather large expenditure of power, and it often had to be decided how far the increased economy of the main sets due to increased vacuum was paid for by the increased power taken by the circulating pumps.

Mr. T. D. Clothier thought that the subject of the paper was one of the side lines that were really the essence of the contract in power-station work. In any ordinary well-conducted undertaking the units generated compared to the units sold were something of the order of 100 to 80; that was to say, 20 per cent. was generated but not sold. The authors indicated a lamentable lack of confidence in the reliability of the supply at their own busbars. When steam that could be considered as surplus was available it was generally advisable to use it for auxiliary purposes; the question to consider was how far the heat of the exhaust steam or the reduction of pressure in high-pressure steam could be regarded as surplus. The use of steam in this form did not take up any portion of the generating plant.

Mr. T. F. Houghton said, regarding the authors' conclusion that feed heating should be accomplished by bleeding the main turbine, and not by exhaust steam from the house sets which, in consequence, should be condensing turbines, that whilst he agreed with the contention as far as feed heating was concerned, a pass-out turbine was worthy of consideration for house service work, the pass-out steam being utilised in a feed-water evaporator. By this means a supply of pure feed water would be available at a fairly high temperature. In general the weight of make-up feed water would be approximately equal to the weight of steam taken for auxiliary purposes. With a four-effect evaporator, therefore, a turbine capable of passing out 25 per cent. of steam would be required. The steam consumption of such a machine would be some 13 per cent. or 14 per cent. greater than that of a condensing turbine. The feed water would, therefore, be obtained at the cost of the corresponding increase in coal consumption of the auxiliary turbine. Taking usual figures, the cost would be about 1s. per 1,000 gallons of water obtained.

Mr. J. H. Collie's idea was that for some of the auxiliaries, especially boiler-feed and circulating pumps, it was desirable to use a steam drive, with either steam or electrically-driven stand-by pumps. The two principal auxiliaries would then be quite independent of the station supply, and as to the difference in efficiency of steam and electric auxiliaries, there was much to choose between them. Also d.c. motors, with their flexibility of speed, were preferable to a.c. motors. A stand-by battery for auxiliaries and lighting appeared to be very desirable.

As to the question of high-speed d.c. generators on the main turbine shafting for auxiliary supplies, such machines were generally satisfactory if the commutator was kept in good condition. They were rather apt to flash over in the event of heavy shorts, and he doubted whether manufacturers would recommend them for such important duty. It would probably be considered better practice to drive such generators by gearing.

Mr. C. Rettie explained, with reference to the question of remote control gear, that he had had a good deal of experience with such gear in marine work, particularly on H.M. ships built and repaired during the war, on the d.c. system, and had never had any trouble with it except an occasional adjustment of the contactors.

Mr. A. Stubbs's views were much in accord with those put forward by the authors; however, the latter were not consistent when they stated that no expense should be spared in order to secure reliability, for they had throughout been trying to strike a balance between running costs and reliability. The authors had decided that economy could be best obtained by taking the auxiliary supply from the main turbo-alternator set, and they appeared to be very reluctant to sacrifice that source of supply. The value of the paper would have been enhanced if figures had been presented in justification of the electrical as against the steam drive. The latter was not condemned because of pipes, valves, and leakages; something much more difficult to deal with was the low efficiency of the small unit. Conditions might vary in accordance with general developments; for example, in modern stations where feed-water temperature appeared to be increasing at the expense of the economiser, and where two-stage heating to 210 deg. F. might be adopted, the auxiliary turbine exhausting at atmospheric pressure could be incorporated in the feed-heating system to better advantage. High steam pressures were presumably unfavourable to the small turbine, but it was possible that still further development (to, say, 1,200 lb/sq.in.g.) would be in conjunction with the double-pressure station, where the second pressure might be about 200 or 250 lb./s.in.g., which was well within the scope of the auxiliary turbine. He agreed that heating steam was best provided from the main turbine, whether it be for feed heaters or evaporators, and suggested that the true comparison in a case of this kind was between running economy and low capital cost, whilst retaining the maximum degree of reliability and simplicity.

A house service set to supply a.c. continuously to half of the essential auxiliaries might be good practice, *i.e.*, a Japanese steam station designed for 100,000-kW capacity consisted of four 25,000-kW main turbo-alternators and two 1,000kW turbo-alternator condensing sets, this station to feed into a hydro-electric system of 400,000-kW capacity. The rise in temperature of the boiler feed due to the exhaust from the turbine-driven boiler feed-pump was only sufficient to give from 15 deg. F. to 25 deg. F. The use of variable-speed a.c. motors of the pole-changing type, together with a limited use of dampers and valves, might yield higher overall efficiencies with no other disadvantage than that of increased cost and an extra switching operation.

The practice suggested by the authors of suddenly starting up the main 25,000-kW set to atmosphere would appear to be very far from that recommended recently in America, *viz.*, that the starting period for 30,000-kW sets should be 1½ hours.

Mr. H. Dickinson said that at present the house turbine seemed to be very much favoured, but experience might prove that this method might be improved upon. The scheme for running two turbines with two circulating pumps was not very satisfactory; if one pump failed one of the turbines would have to be shut down, or one pump could be utilised to supply the two condensers, which could not be considered an efficient stand-by. A better arrangement might be three pumps so arranged that in the event of one pump failing there would be still one to fulfil the full requirements of each turbine. A.c. motors were very reliable, but d.c. motors had given very great satisfaction, and if somewhat more attention was required in connection with the latter on account of the brush gear, &c., the extra cost was not a serious factor if one were considering the use of a battery as a stand-by. As time went on this factor of security would lead to a more general use of batteries for stand-by purposes in generating stations.

Mr. F. J. Teago suggested that an a.c. motor of the Schrage type had all the advantages of, and was simpler to operate than, a d.c. motor, since it required no starter and speed variation was obtained by simply turning the brush-shifting handle; the motor also had a smooth speed range of 5 to 1 and could operate at unity power factor. Where it was desired to start up a "dead" station with auxiliaries driven by a.c. motors, was it a feasible proposition to install a Diesel alternator set to run the auxiliary plant until the station was on load?

Large Electrically-driven Pulp and Paper Mill.—The *Electrical News* recently described what is said to be the most modern pulp and paper mill in the world. This belongs to the St. Maurice Lumber Co., and is situated at Three Rivers, Quebec. The approximate electrical load of the mill is 23,500 h.p., and the power is supplied by the Shawinigan Water & Power Co. from its hydro-electric plant 25 miles distant. The three-phase, 60-cycle current is transmitted over two lines at 60,000 V to a transformer sub-station housing six 4,000-kVA single-phase transformers in two banks. These oil-insulated, water-cooled transformers step the current down to a secondary pressure of 2,200 V. At this pressure about two-thirds of the power is taken to the wood grinding motors, which represent a load of 16,500 h.p. The remainder of the power is transmitted to a secondary sub-station, where it is stepped down to 550 V for distribution to the paper machines (3,000 h.p.), the sulphite screen room (1,548 h.p.), the pump house (1,862 h.p.), and other buildings.

Practically the whole of the plant and machinery is of Canadian manufacture; the electrical construction and mechanical piping installation was carried out by the Canadian Comstock Co., Ltd., of Montreal and Toronto.

LEGAL.

Tanner Bros. v. India Rubber, Gutta Percha and Telegraph Works Co., Ltd.

According to the Manchester *Daily Dispatch*, damages amounting to £5,618 were awarded by Mr. Justice Greer, at Manchester Assizes, on May 15th, to Messrs. Tanner Bros., Waterside Mill, near Oldham, who claimed for breach of contract against defendants following a contract for the delivery of 60,000 lb. of cotton yarn, which defendants subsequently repudiated. The amount named represented the difference between the contract price and the market value twelve months afterwards.

A counter-claim by the defendants was dismissed.

Workmen's Compensation Case.

At the Birmingham County Court, on May 16th, before his Honour Judge Amphlett, judgment was given in a claim for an award under the Workmen's Compensation Act brought by Charles Robert Salsbury, turner, of 172, Brantley Road, Witton, against the General Electric Co., Ltd., Witton. Salsbury was first employed by the respondents in 1920, and in September of the following year met with an accident to his right eye through the breaking of one of his tools while he was working at a machine. As a result he lost the sight of the eye, and received a lump sum of £125 under a registered agreement which terminated the company's liability. On November 2nd last year he met with an accident under similar circumstances, his left eye being injured, this time by a piece of broken tool. He was paid the full rate of compensation up till November 23rd, when it was discontinued on the ground that the injury to the left eye had disappeared and that he was able to resume his old employment.

Medical experts differed, said his Honour, as to the suitability of this work, but he preferred the evidence given on behalf of the applicant. On the facts he came to the conclusion that the work was not suitable, and there would be an award of compensation.

An Edinburgh Compensation Case.

Intimation was made in the Court of Session, Edinburgh, of the settlement of an action in which a widow and her son sued Edinburgh Corporation for £5,000 and £1,000 respectively as damages for the death of Charles Hogg Cuthill, baker and confectioner, at 77, St. Leonard's Street, the husband of the first pursuer and father of the second. Early on the morning of August 2nd last Cuthill went to work in his bakehouse, the floor of which is below, and the ceiling of which is above, the level of the street. Owing to the suffocating nature of the atmosphere in the bakehouse he almost immediately went upstairs to his shop, where he collapsed on the floor and died of suffocation. The pursuers averred that carbonic acid gas penetrated through the wall of the bake-house from an electric main cable belonging to the defenders, and laid underneath the pavement in St. Leonard's Street. It was stated that the cable fused, producing large volumes of smoke and poisonous gases, which penetrated the bake-house and caused Mr. Cuthill's death. Fault and negligence were alleged against the defenders. The defenders admitted that a short circuit occurred opposite or near Mr. Cuthill's shop, and that the products of the combustion which followed penetrated into the bake-house, the front wall of which, they said, was in a defective condition. They denied that the accident was due to any fault or failure of duty on their part. The defenders have now made payment of £1,500 and expenses to the pursuers in settlement of their claims, and the action has been taken out of court.

MID-LANCASHIRE ELECTRICITY DISTRICT.

The Electricity Commissioners' Decisions.

The Electricity Commissioners have considered the evidence given at the inquiry held at Preston, in February last, into the schemes submitted (*a*) jointly by the Corporations of Blackburn and Preston for the establishment of a Joint Electricity Authority; (*b*) by the North-East Lancashire Electricity Committee for the establishment of an Advisory Board; and (*c*) an agreed amended scheme submitted by both parties during the course of the inquiry for the establishment of an Advisory Board. The conclusions of the Commissioners are that the district as provisionally determined is confirmed. The agreed technical scheme which the Commissioners approve generally deals with the district in two portions;

The Central and Eastern Area.—The new stations at Blackburn and Preston are to be utilised together with the existing stations at Accrington, Burnley, Colne, Darwen, Nelson, and Rawtenstall, which are not to be further extended except in the case of the stations at Nelson and Rawtenstall, and unless otherwise determined hereafter, in the case of the stations at Colne and Darwen. Provision is also made for the shutting down in due course of the two existing stations at Preston and the Jubilee Street station at Blackburn. The scheme further provides for the establishment during the first stage of development of transmission lines between Preston, Blackburn, Accrington, Burnley, Brierfield, and Nelson, to supplement the lines already existing between Blackburn and Darwen, Nelson and Colne, Accrington and Rawtenstall *via* Haslingden, and between Rawtenstall and Bacup As regards subsequent developments, it was agreed that further consideration should be given to the question of establishing a main transmission line connecting Rawtenstall with the main system. A new generating station is also to be erected at Padiham, when required, either by the Corporation of Burnley or by the Lancashire Electric Power Co. Provision is made for the submission to the Commissioners of a scheme of control of the interconnected generating stations.

The Western Area.—The generating stations at Blackpool and Fleetwood are to be extended and utilised together with the station at Lytham-St. Annes, which is not to be further extended unless otherwise determined hereafter. Provision is also made for the giving of supplies from the Blackpool station to Bispham and to Lytham-St. Annes.

The agreed scheme of administration provided for the establishment of an Advisory Board; an Engineering Committee for the whole district; and of three sub-committees for the central, eastern and western areas respectively, to deal with matters affecting solely the interests of the authorities within the said areas.

It appeared to the Commissioners that there would be some advantage in making provision on the Advisory Board for the direct representation of local authorities other than authorised undertakers instead of for the county council as proposed; and for the representation, either jointly or otherwise, on the Engineering Committee, of other authorised undertakers established hereafter in the district.

The proposed appointment of three separate administrative sub-committees is a matter which should be left open for the present, as it is not clear to the Commissioners that definite advantages would accrue from the proposed sub-division of the administrative duties of the Advisory Board. While the Commissioners do not consider that a case has been made out for the compulsory appointment of sub-committees, they see no objection to the granting of enabling powers whereby such sub-committees could be appointed in the future if the circumstances were found to justify such a course.

Subject to the foregoing observations, the Commissioners approve generally the agreed proposals for the administration of electricity supply in the district, and they will prepare a draft Order giving effect to their decisions prior to the holding of the further local inquiry required by Section 5 (4) of the Electricity (Supply) Act, 1919.

PARLIAMENTARY NOTES.

[By our Special Parliamentary Reporter.]

Lytham-St. Annes Corporation Bill.—The Borough of Lytham-St. Annes was incorporated in November, 1922, and comprises the areas of the former Lytham Urban District Council and St. Annes-on-Sea Urban District Council, and all the rights, &c., vested in those urban district councils were vested in the Corporation. In a Bill which was ordered to await report for third reading by the Unopposed Committee of the House of Lords, on May 15th, there are powers relating to the tramway and the electricity undertakings of the Corporation. The tramway undertaking is to continue vested in the Corporation, and power is given to work tramways and to generate electricity for that purpose, but the Corporation will have to obtain the consent of the Electricity Commissioners to the establishment of a new, or the extension of an existing generating station. The gauge is to be 4 ft. 8½ in., or such other gauge as may be approved by the Minister of Transport, and the rails are to be such as the Minister of Transport may approve. Another part of the Bill provides that the electricity undertaking shall continue to be vested in the Corporation, applies provisions of the Electric Light (Clauses) Act, 1899, and defines the area of supply as the Borough. The maximum to be charged for electricity per quarter is 13*s.* 4d. for any amount up to 20 kWh, and 8d. for each additional kWh.

Birkenhead Corporation Bill.—This general powers Bill has been under consideration by the Local Legislation Committee of the House of Commons. Part III, which deals with tramways and omnibuses, gives power to construct a tramway (a double line over 5 furlongs in length) connecting at each extremity with existing tramways of the Corporation. If the tramway is not completed within five years or any extended period approved by the Minister of Transport, the powers in relation to it are to cease. The gauge is to be 4 ft. 8½ in., or such other gauge as may from time to time be approved by the Minister of Transport. In the Bill as deposited it was sought to run omnibuses, but there was

opposition by those at present running omnibuses, and the Committee did not allow the powers sought.

Power is contained in the Bill to borrow £19,000 for the construction of the tramway, and £1,300 for equipment, the periods of repayment being 30 years and 20 years respectively from the dates of borrowing.

The powers relating to the tramway and the electricity undertaking are approved by the Committee.

Metropolitan Railway (Various Powers) Bill.—This Bill was ordered to be reported for third reading by the Unopposed Committee of the House of Lords on May 15th. There were no amendments.

Maidstone Corporation Bill.—This Bill, which was recently considered by a Committee of the House of Lords, and has now been reported for third reading, contains provisions with regard to trolley vehicles, omnibuses and light railways, and to the electricity undertaking of the Corporation. Power is given to run trolley vehicles over specified routes, and there are a number of usual provisions with regard to electrical works and equipment, public safety, &c. The borrowing powers are £5,400 for the provision of trolley vehicles, £5,300 for the provision and erection of posts and other apparatus, £4,800 for the provision of omnibuses, and £3,500 for the purchase of lands and the erection of buildings for the purposes of the light railways, trolley vehicles and omnibuses. With the consent of the Minister of Transport, also, further money may be borrowed, as may be necessary, for the purposes of the undertaking.

Bradford Corporation (Trolley Vehicles) Provisional Order (No. 1).—This Provisional Order, which was passed by the Unopposed Committee of the House of Commons on Wednesday, May 16th, confirms an Order made by the Minister of Transport authorising new routes for trolley vehicles in Bradford.

Wimbledon and Sutton Railway Bill.—This Bill, to extend the time for the compulsory purchase of lands and for the construction and completion of the railway authorised by the Wimbledon and Sutton Railway Act of 1910, and to raise additional capital, was ordered to be reported for third reading by the Unopposed Committee of the House of Commons on Wednesday, May 16th. Mr. R. B. Baxter explained to the Committee that the railway authorised in 1910 was that between Wimbledon and Sutton, about 5½ miles long. (This was deal with in the proceedings on the City and South London Railway Bill, reported in our issue of May 4th, p. 718.) The Act of 1910, incorporating the Wimbledon and Sutton Railway Co., was promoted by certain landowners, but they were unable to raise the capital authorised, and in 1912 or 1913 they had asked for the assistance of the Underground group of companies. In 1913 a further Act was passed, which extended the time allowed for construction and authorised further capital, and in the early part of 1914 all arrangements had been made, but the work was held over as the result of the war. Further extensions were subsequently granted by the Board of Trade and the Ministry of Transport, and the time limit for the compulsory purchase of lands and for the completion of the railway was July 26th, 1924; the present Bill extends the time to July 26th, 1928.

In the City and South London Railway Bill there was a clause under which four of the underground companies (the District, Central London, City & South London and the London Electric) had a permissive power to subscribe for the share capital and debentures of the Wimbledon and Sutton Railway Co., or to guarantee the interest on them, so that there is every hope that, if this extension of time is granted, the work will be put in hand very shortly. The total capital authorised at present is £550,000, and there is power to borrow up to one-third of the paid-up capital. The capital issued is £5,350, in £10 shares. It is estimated that, owing to increased costs of materials, labour, &c., the cost of the railway, rolling stock, &c., will now amount to about £1,300,000, and powers are asked for in the Bill to raise a further £600,000 additional capital, and to borrow up to half the amount of the paid-up capital.

Automatic Train Control.—On May 15th, COLONEL ASHLEY, replying to Mr. Charleton, said that the recommendations of inspecting officers were brought to the notice of the railway companies concerned in every case, and in addition the companies had been asked to consider the important conclusions arrived at by the Departmental Committee on Automatic Train Control, whose report was published last year. In accordance with this request the companies had appointed a committee of experts on the matter, and that committee was now sitting.

Electricity Commissioners' Refunds.—Replying to Sir John Leigh, on May 15th, COLONEL ASHLEY said that the sum of £30,000 not expended by the Electricity Commissioners during the current financial year in respect of advances made by the Ministry of Transport Vote would be repaid to the Exchequer as an extra receipt.

Workmen's Compensation.—The Home Secretary has introduced a Bill "to amend the Workmen's Compensation Act, 1906, and the Acts Amending that Act, and to amend the law with respect to employers' liability insurance, the notification of accidents, first aid and ambulance."

Private Bills.—The Oakham Gas and Electricity Bill and the City and South London Railway Bill have been read a second time in the House of Commons. The Royal Assent has been given to the Metropolitan Railway (Various Powers) Bill and the London County Council (General Powers) Bill.

Special Orders.—The Special Orders relating to the following districts have been approved in both Houses: Radyr (Cardiff), Street (Somerset), Welwyn Garden City (Herts.), Teignmouth, Kirkwall (Orkney), and South-East Lancs. (constituting an Advisory Board).

Whitsuntide Adjournment.—Parliament rose for the Whitsuntide recess on Thursday, May 17th, and will re-assemble on Monday, May 28th.

The Premier's Resignation.—Mr. Bonar Law having been compelled to resign his position as head of the Government, through continued ill-health, the King has asked Mr. Stanley Baldwin, Chancellor of the Exchequer in Mr. Bonar Law's Government, to form a new Ministry. Mr. Baldwin has been M.P. for the Bewdley division of Worcestershire since 1908, and has held office since 1917, when he was appointed Financial Secretary to the Treasury. Prior to this appointment he was prominent in the iron and steel industry, being a director of Baldwins, Ltd.

BUSINESS NOTES.

Bankruptcy Proceedings.—LEWIS SAGER (lately trading as the Venus Electric Co.), 86, York Road, Lambeth.—The public examination of this debtor was held on May 15th, before Mr. Registrar Mellor, at the London Bankruptcy Court, the accounts showing liabilities £623, and assets nil. Debtor stated that he came to England in 1914, and for some years carried on a hotel and catering business in Whitechapel. In January, 1922, he and another person entered into partnership and started to trade in electric lamps and globes, under the above style. The globes, which were imported from Austria, were an infringement of the patent rights of English manufacturers; in consequence the business was not continued, and the globes were subsequently disposed of at a loss, to which fact the debtor largely attributed his failure and insolvency. The examination was concluded.

ALFRED JAMES BARLOW (trading as Barlow Bros.), 9, Brunswick Place, City Road, E.C., electrical and general engineer.—The first meeting of creditors was held on May 15th, at the London Bankruptcy Buildings, Carey Street W.C. The receiving order was made on April 26th, upon the debtor's own petition. Mr. Ernest Parke, Official Receiver, reported that it appeared from the debtor's statements that he commenced business as above in 1911, and the trading had been successful throughout, his present position being due entirely to losses by bad debts. During the last eighteen months he had been obliged to sue quite a number of debtors. A private meeting of his creditors was held at Anderton's Hotel on April 16th, and after the proceedings had been adjourned for a week he was called upon to execute a deed in favour of a trustee, with a view to the position being investigated. The deed was signed, but was never registered, and nothing was done thereunder, because when a creditor threatened legal proceedings to recover a debt of £166, the debtor, acting on the advice of his solicitor, filed his petition. No statement of affairs had been lodged, but the debtor roughly estimated his liabilities at £1,600, and valued his assets at £820, the chief items being stock, £100; machinery, £300; and book debts, £400. The failure was attributed entirely to bad debt losses; the debtor admitted that he had been handicapped by trade depression, but was of opinion that he could have got over that trouble if his customers had paid promptly. The chairman added that on the making of the receiving order the principal creditors applied for the appointment as special manager of Mr. Albert Willmott, in order that he might carry through certain uncompleted contracts, and continue the business until the first meeting of creditors, with a view to preserving the goodwill. He complied with the application, and Mr. Willmott had kept the business going up to date. Mr. Bruxholm, on behalf of the debtor, said he was unable to submit any offer, and a resolution was passed for Mr. Willmott (Francis Nichols & White, C.A., 14, Old Jewry Chambers, E.C.) to wind up the estate as trustee in bankruptcy, assisted by the following committee of inspection, *viz*:—Mr. H. R. Cooper, Mr. S. B. Wright, and Mr. C. S. Beard.

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Frederick Arthur Pilbrow, trading as H. & J. West, 7b, Stoke Road, Gosport, electrical engineer.—The receiving order in this matter was made on April 20th on debtor's own petition. The statement of affairs shows liabilities of £294, and the assets are estimated to realise £123, from which have to be deducted preferential claims of £28, leaving net assets of £95, or a deficiency of £199. Debtor attributed his failure to ill-health, bad trade, and costs on writs, summonses, and executions. It appears that he was in the Army from July, 1914, to December, 1919, and when he left he received a gratuity of £35 and a pension of 8s. per week. In February, 1920, he purchased the stock and trade effects of the business of an electrical engineer at 52, King's Road, Gosport, which had been carried on under the name of H. & J. West. He states that he had a capital of £110, and he paid a deposit of £50 and continued trading as H. & J. West. In December, 1920, he removed to his present address, but there had been a scarcity of work ever since, and he had been aware of his position for the last two years. The following are creditors:—

	£		£
Bordesley Electric Accessories Co., Ltd.	15	Vulcan Electric Co., Ltd. ...	100
The India Rubber Co.	15	Walsall Hardware Manufacturing Co., Ltd.	15
Napier Kimber, Ltd.	14	West, R. S.	30
Richmond & Chandler, Ltd. ...	15		

Sarkis Balthazar Sukiassian, otherwise known as B. Sukiassan, 12, Roxborough Avenue, Harrow-on-the-Hill, Middlesex, late 137, Cheapside, London, merchant.—The first meeting of the creditors of the above was held on May 16th at 29, Russell Square, London, W.C.1. The matter was referred to on p. 770 of our last issue. The creditors decided to leave the matter in the hands of the Official Receiver as trustee of the estate. The following are creditors:—

	£		£
Ashley, Tee & Sons	30	Hudson (exors. of)	50
Babayan, M. A.	500	Hughes & Co., Ltd.	232
Boote, Edgar & Rylands	60	Jameson Bros.	200
Carter, Paterson & Co., Ltd. ...	14	Kapamadjian, M.	35
City Woollen Co.	16	Kendal, Milne & Co., Ltd. ...	70
Clarke & Co.	30	Kricorissian, O.	700
Cooper, H. G., Ltd.	24	Mezbourian, M.	307
Cowan, J.	200	Norman, Dr.	30
Crabbe & Son	120	Parker's Stores	18
Dyer & Co., Ltd.	139	Post Office Telephones	18
Eccleston, H. F.	28	Price, T.	16
Elyguzel, H. G.	700	Roberts, J. H.	29
Evans, R. E.	15	Shaw, J. & J.	110
Farris & Co.	13	Smith, J. (1908), Ltd.	32
Funduklian, E., & Co.	100	Stonebridge Electrical Co., Ltd.	40
Holcombe, Brook & Co., Ltd. ...	34	Veevers, J. S., Ltd.	70
Holt, Moseley, J. S., & Co., Ltd.	34		

L. A. Brown, electrician, The Street, Frensham, Surrey.—Trustee, Mr. T. Gourlay, Official Receiver, 29, Russell Square, W.C.1, released April 11th.

T. G. Coaton (T. G. Coaton & Co.), electrical engineer, 16, Humberstone Road, Leicester.—Last day for proofs for dividend June 2nd. Trustee, Mr. E. H. Hawkins, 4, Charterhouse Square, E.C.1.

F. L. Perrin, electrical engineer, 57, Wellingborough Road, and 5, College Street, Northampton.—Last day for proofs for dividend, June 1st. Trustee, Mr. H. C. Palmer, Kingham Chambers, Abingdon Street, Northampton.

H. J. A. Maullin (Wilton Engineering Co.), electrical engineer, 206, Lozells Road, Hockley, and 124, Devonshire Street, Birmingham.—First and final dividend of 4s. 4d. in the £, payable May 28th at the Official Receiver's office, Ruskin Chambers, 191, Corporation Street, Birmingham.

D. W. Close (Ayrshire Electrical Co.), New House, Kilbirnie, and 29, Central Avenue, Garden City, Kilbirnie.—Public examination May 23rd at the Sheriff Court House, Kilmarnock. Meeting of creditors May 31st at the offices of Messrs. Wilson, Stirling & Co., 93, West George Street, Glasgow.

A. H. Duffin and G. Kershaw (A. H. Duffin & Co.), electrical engineers and contractors, Provincial Buildings, Conway Road, Colwyn Bay.—Receiving order made May 12th on debtors' own petition.

R. Rudd, electrical engineer, Long Ashton, Somerset.—Receiving Order made May 15th on debtor's own petition. First meeting, May 30th, at the Official Receiver's Offices, 26, Baldwin Street, Bristol; public examination, June 15th, at the Guildhall, Bristol.

H. B. West, electrician, 3, Clyde Street, Canterbury.—Receiving order made May 16th on debtor's own petition. First meeting May 26th at the Official Receiver's office, 10, Burgate Street, Canterbury. Public examination June 16th at the Guildhall, Canterbury.

R. T. Morrison, electrical engineering contractor, 82, Lumb Lane, Bradford.—Trustee, Mr. W. Durrance, Official Receiver, 12, Duke Street, Bradford, released April 20th.

F. A. S. Wormull (Lewisham Electric Wiring Co.), electrical engineer, 273, High Street, Lewisham.—Trustee, Mr. T. Gourlay, Official Receiver, 29, Russell Square, W.C., released April 20th.

S. G. Wilkinson, electrician, 76, High Road, Wembley.—First meeting, May 31st, at 29, Russell Square, W.C.; public examination, June 20th, at the Court House, St. Albans.

F. A. Watkins, electrical engineer, 57, High Street, Hythe, Kent.—Last day for proofs for dividend, June 4th. Trustee, Mr E. H. Hawkins, 4, Charterhouse Square, E.C.1.

T. Davison (Radio Technical College), 30, Falkner Street, Liverpool.—Last day for proofs for dividend, June 6th. Trustee, Mr. E. D. Symond, 11, Dale Street, Liverpool.

J. S. Turner (Stanley Motor Co.), electrical and motor engineer, 542, Stanley Road, Bootle.—First meeting, June 1st, at the Official Receiver's Offices, 11, Dale Street, Liverpool; public examination, July 3rd, at the Court House, Liverpool.

Company Liquidations.—Ventiheta, Ltd.—A petition for the winding-up of the company has been presented to the High Court by Mr. W. B. Dick, of 55, Harrington Gardens, South Kensington, S.W., a creditor, and will be heard in London on May 29th.

Chichester Electric Light & Power Co., Ltd.—Winding up voluntarily. Liquidator: Mr. V. W. Grosvenor, 70a, Basinghall Street, E.C. Meeting of creditors at Bassishaw House, Basinghall Street, May 31st. Particulars of claims to the liquidator by June 18th.

Armature Repairing & Supply Co., Ltd.—Winding up voluntarily. Liquidator, Mr. A. O. John, Fisher Street, Swansea. Meeting of creditors June 1st, at Central Buildings, Fisher Street, Swansea.

Russell Electrical Appliances Co., Ltd.—Meeting of creditors June 1st, at the office of the liquidator, Mr. A. Neill, Bank Chambers, 76, Kingsland High Street, E.8.

Dissolution of Partnership.—Segers & Bradshaw, wireless engineers and agents, Sudbury, Suffolk.—Mr. S. M. Segers and Mr. C. W. Bradshaw have dissolved partnership. Mr. Segers will attend to debts and continue the business in his own name.

Trade Announcements.—Mr. E. W. Bond, electrical contractor, of 34, Millais Road, Dover, desires to receive catalogues and lists of electrical accessories.

Mr. T. W. Clarke, of Horbury (Yorks.), has added to his business a branch for electrical work.

Messrs Smith & Ansell, Ltd., have this week removed to larger works at Stockfield Works, Stockfield Road, Acocks Green, Birmingham. Telephone No.: "Acocks Green 269."

Engineering Supplies, Ltd., owing to extended business, has acquired larger premises at 235a, Blackfriars Road, London, S.E., where comprehensive electrical stocks will be carried.

The Scottish Motor Traction Co., Ltd., has taken showroom premises at 12, Bothwell Street, Glasgow, the lease of its present premises having expired. 'Phone: Central 6521.

We are informed that Messrs. Vickers, Ltd., have acquired a substantial interest in the Spearing Boiler Co., Ltd., and that the name of the latter company will be changed to Vickers-Spearing Boiler Co., Ltd. The directors on the new board will be:—Mr. A. H. Spearing, chairman; Mr. J. Kerr-Bock, of the Spearing Boiler Co., Ltd.; Mr. Douglas Vickers, chairman of Vickers, Ltd.; and Sir Vincent Caillard, of Vickers, Ltd. It is intended that the manufacture of all classes of land boilers will be carried out at the Barrow works of Vickers, Ltd.

Catalogues and Lists.—The Metropolitan-Vickers Electrical Co., Ltd., Trafford Park, Manchester.—A binding cover containing a large number of illustrated and priced pamphlets in 16 sections, dealing with "Cosmos" lamps, wiring accessories, insulators, switch- and fuse-gear, conduits and conduit fittings, lighting fittings, domestic appliances, radio apparatus, &c. The publication forms a very comprehensive guide to the company's smaller products.

Enterprise Manufacturing Co., Ltd., Electric House, Grape Street, Shaftesbury Avenue, W.C.2.—A price list of electric fans and small motors.

Messrs. Todman, Ryall & Co., Ltd., 38, Grosvenor Gardens, Westminster, S.W.1.—Current stock list of d.c. motors and dynamos of various voltages and capacities.

Messrs. W. H. Sugden & Co., Ltd., Glenny Road, Barking, Essex.—A descriptive stock list of a.c. and d.c. motors.

Simplex Conduits, Ltd., Garrison Lane, Birmingham.—Booklet No. 980, an illustrated catalogue of electric signs, bowl lighting fittings, &c. Fully priced.

The Cambridge & Paul Instrument Co., Ltd., 45, Grosvenor Place, S.W.1.—A comprehensive illustrated catalogue of instruments for power stations, including mechanical and electrical thermometers, CO_2 apparatus, pressure and vacuum gauges and recorders, &c.

The Benjamin Electric, Ltd., Brantwood Works, Tariff Road, Tottenham, N.17.—The "Benjamin Bulletin" for May, dealing with automobile appliances, &c.

Messrs. Watson & Sons (Electro-Medical), Ltd., Sunic House, Parker Street, Kingsway, W.C.2.—Bulletin 535, describing "Sunic" high-frequency apparatus for violet-ray treatment and a folder dealing with "X-Ograph" dental film packets.

The British Thomson-Houston Co., Ltd., Crown House, Aldwych, W.C.2.—A handbook (No. 1D), containing a large amount of information relating to incandescent lamps, with prices of "Mazda" lamps. Also a pamphlet giving reduced prices of electric fans.

Trade and Industry in Germany in April.—The Commercial Secretary at Berlin (Mr. H. N. Sturrock) has forwarded to the Department of Overseas Trade a report, based on the reports of the Prussian Chambers of Commerce, on German trade and industry during April, in which he says: "In the electrotechnical industry a further decline of business activity was recorded. The difficulties in the way of obtaining coal and semi-manufactures owing to the occupation of the Ruhr were overcome, but delivery contracts were delayed in consequence of railway transport difficulties."

British Trade-Mark Applications.—The following are included among the recent applications for British trade marks. Objections may be lodged within one month from the dates mentioned. In the case of foreign applications, the names and addresses of the British representatives are also given :—

Textolite. No. 434,451. Machinery of all kinds in Class 6.—The British Thomson-Houston Co., Ltd., Crown House, Aldwych; London, W.C. May 16th, 1923.

Ethovox. No. 434,865. Class 8. Instruments and apparatus for use in wireless telephony.—Burndept, Ltd., Aerial Works, Blackheath, London, S.E. May 16th, 1923.

Procophone. No. 434,898. Class 8. Apparatus for use upon or in connection with telephones and like instruments.—The Progress Co., 35, Ely Place, Holborn Circus, London, E.C. May 16th, 1923.

Victor (lettering and design). No. 435,108. Class 8. Instruments, apparatus, and component parts for use in wireless telegraphy and telephony.—Victor Radio, Ltd., 3, Chapel Street, Salford, Manchester. May 16th, 1923.

A.B. (lettering and design). No. 435,861. All goods in Class 8.—Anderson, Boyes & Co., Ltd., Flemington Electrical Works, Robberhall Street, Motherwell, Glasgow. May 16th, 1923.

Durabit. No. 430,652. Class 50. Electrical insulating tapes composed of a textile material impregnated with india-rubber.—Kampy & Schonmann, Kabel Isolierband und Gummiwarenfabrik Durabit, 5, Zollergasse, Vienna VII, Austria. (Marks & Clerk, 57-58, Lincoln's Inn Fields, London, W.C.) May 16th, 1923.

Electric Motor Manufacture at Sydney.—Several weeks ago we referred to the operations of Messrs. Parkinson Australia, Ltd., who had laid out a works in Sydney, N.S.W., to duplicate the manufacture of the products of the parent company, Messrs. F. & A. Parkinson, Ltd., Guiseley, Leeds. The Australian factory which commenced operations in July last year, is situate in the centre of a large residential suburb about 4½ miles out of Sydney, conveniently, therefore, from the standpoint of good class labour. We give in the accompanying photograph a view of one of the workshops. The factory site itself covers about six acres of land near the main railway, and ample room has been left for extension as the business grows. The works have been running at top pressure, and the need for a standardised motor with rapid delivery, usually from stock, is being met.

The Parkinson Electric Motor Works at Sydney, N.S.W.

Industrial Disputes.—The Minister of Labour, recently replying to a question regarding industrial disputes, said that the total numbers of disputes in the last three years were :—1920, 85 (involving 55,939 workpeople); 1921, 400 (affecting 1,683,631 workers); and 1922, 261 (involving 173,302).

The Boilermakers' Lock-out.—The *Daily Herald* stated on May 21st that it was informed on good authority that the Federation of Engineering and Shipbuilding Trades had expelled the Boilermakers' Society as from the date when the Society ceased to take part in the recent negotiations on the overtime agreement. This action forestalls the proposal of the Boilermakers' Society to withdraw from the Federation subject to this proposal being ratified at the June meetings of the Society.

A Three-Legged Stool.—"I always illustrate business as a three-legged stool, there are capital and labour and management; the three must stand together to support the stool in its burden. Withdraw any one of them and the whole structure must fall, and therefore we must see that labour receives its proper return, that capital receives its proper return, and that management in a great business be adequately rewarded for that which it has to do. Now, if that be true of business and its three component parts, how important is it that the whole world should work co-operatively for the good of each other, and for their own good."—*Mr. C. M. Schwab, addressing a luncheon meeting of the British Empire Chamber of Commerce in the U.S.A., at New York, in April.*

Russia Ordering Generators Abroad.—The chief constructional engineer Graftyn, of the Volchoff Works, has returned to Petrograd from Stockholm, where he has been to treat with foreign houses for the supply of generators and oil switches for the hydro-electric station. Offers were received from the German firms, Siemens & Schuckert and the A.E.G.; from Vickers; the Swedish A.S.E.A.; and from the Czecho-Slovakian firm of Skoda. The distribution of the orders must take place in May to ensure proper delivery. The value is about one million gold roubles. The construction of the 10 turbines at the Nichvis and Cholm factory, Sweden, is proceeding satisfactorily. Their total cost is two million gold roubles, and they are to be ready by February, 1924.

First Australian-made Turbo-Alternator.—On March 26th last the first turbo-alternator to be built in Australia was put into commission. This is in the Ultimo (Sydney) power station of the N.S.W. Railway Commission, and is a 2,500-kW set made by the English Electric Co., of Australia, Ltd. The turbine is of the impulse type, with one compound stage and six simple stages, working with a 160 lb. per sq. in. pressure and 28½ in. vacuum. The alternator is connected to the turbine through a flexible coupling and delivers 3-phase current at 2,300 V, 50 cycles. A similar machine to this is almost completed, and the company also has in hand a 18,750-kW set for the Commission's White Bay station.

Unemployment.—The number of persons on May 7th recorded on the live registers of the Employment Exchanges in Great Britain as wholly unemployed was 1,203,800. This was 14,467 less than in the preceding week, and 282,078 less than the figure on January 1st, 1923.

The number working short time and drawing benefit for intervals of unemployment was 55,200 on May 7th, as compared with 38,271 on April 30th, and 56,261 on January 1st, 1923.—*The Times.*

British Industries Fair Catalogues.—The Department of Overseas Trade considers that the catalogues printed in connection with the 1923 Fair form useful books of reference; there is still a limited number of copies available, and these may be obtained from the D.O.T. at the price of one shilling each, post free.

Competition Result.—We are informed that Messrs. Troughton & Young, electrical contractors, have won the Hoover window-dressing competition, which carries with it a cheque for £25.

Book Notices.—Circular No. 138 of the U.S. Bureau of Standards, "A Decimal Classification of Radio Subjects—An Extension of the Dewey System." (33 pp.) Washington: Government Printing Office. Price 10 cents.—This is a description of the system prepared by the Bureau of Standards to meet the increasing demand for a systematic classification of radio literature.

"Workshop Routine," by W. J. Hiscox. Pp. x+159. Illustrated. London: Chapman & Hall, Ltd. Price 9s. 6d. net.

"Physics in Industry," by Prof. Archibald Barr, Sir Jas. Ewing, F.R.S., and Mr. C. C. Paterson. Vol. I, "Lectures Delivered before the Institute of Physics." Pp. 59. London: Henry Frowde and Hodder & Stoughton. Price 2s. 6d. net.

"*Journal* of the American Institute of Electrical Engineers." Vol. XLII. No. 5 May, 1923. New York: The Institute. Price $1.

Anglo-American Co-operation.—In the course of his speech in New York to the British Empire Chamber of Commerce, Mr. Chas. M. Schwab, of the Bethlehem Steel Corporation, said: "England and America must be the workshops of the world, and they must be the shippers to the world. German efficiency has been destroyed for many years to come, but we must look out for the fact that ultimately German labour, after being tried in the crucible of the ordeal through which they are now passing, is going to play an important part in the industry of the world; we must realise that fact, because some day we will have to meet it, and we will wake up to the realisation of the fact that, although we have won this great war, the German people, by reason of their efficient labour, their willing labour, will reap the real benefit of the war. Now, it may not be in our time, but it will come, unless we awake to the realisation of our own importance, of our own co-operation and the necessity of our reaching the greatest economy in co-operative work." In comparing British and American abilities and industrial conditions the speaker said: "Speaking of my own industry, I know we can manufacture cheaper than you do in Great Britain, but I know also that you can ship a great deal cheaper than we can. I know, notwithstanding my distinguished friends here, that you can do foreign banking, invoicing, letters of credit, far better in Great Britain than we do here; but, on the other hand, we have conditions the result of which will be competition that is destructive to both our profits and both our successes. Great Britain's fault—I will not call it a fault—to-day is with reference to the fact that labour and capital there do not seem to understand each other quite as well as we do here. We are not perfect, but in Great Britain I think it is worse, because you are not getting the efficiency from labour in your works there that we here get per man, and it is only with the co-operation and understanding of labour that you will be able to get your costs in these great basic commodities as low as we get our costs for export business."

Foreign Exhibition.—SWEDEN.—The Skaane Fair at Malmoe will be held this year between July 30th and August 5th. As previously, the Fair will include a special inventions section. —*Reuter's Trade Service* (Stockholm).

The Placing of British Public Contracts Abroad.—Our views on this subject are well-known to our readers, as we have felt obliged to state them on several occasions during the last few months. We may, however, draw attention with approval to the issuance of a communication from the Minister of Health to the local authorities in England and Wales, including joint boards and port sanitary authorities, on the subject of grants in connection with works for the relief of the unemployed. The *Manchester Guardian* says that the circular states that the Government has decided that, as regards all works in respect of which grants are given expressly because of unemployment by the Unemployment Grants Committee, or by any Government Department, it shall be a condition of the grant that all contracts for or incidental to the works are to be placed in this country. This follows a similar condition with regard to schemes in respect of which guarantees are given under the Trade Facilities Act. "The Government also urge," adds the Minister, "that in view of present conditions the same principle should be adopted in the absence of special circumstances, in the case of all contracts in respect of works carried out by local authorities, whether or not the expenditure on the works is assisted by grants from the National Exchequer or from the Road Fund."

A Pocket Book.—Messrs. A. Reyrolle & Co., Ltd., have sent us a neat pocket note-book of the loose-leaf type bound in suede leather. The front and back leaves bear illustrations of the company's products.

Exporters' Problems.—The Federation of British Industries has recently set up a new committee to consider questions affecting the interests of manufacturers in their export trade. The first meeting was held on May 8th, and among the concerns represented (according to the F.B.I. *Bulletin*) were Messrs. Vickers, Ltd., C. A. Parsons & Co., Ltd., the B.E.A.M.A., the British Engineers' Association, and the National Federation of Iron and Steel Manufacturers. Such matters as the position of shippers in respect of craneage charge at docks and the possibility of standardising international requirements with regard to signatures of bills of lading were under consideration.

Sydney Gives British Manufactures a Substantial Preference.—The Sydney City Council having adopted a definite policy of absolute preference to plant or material made in Great Britain or a British dependency for a period of two years, has just given practical proof of its intention to carry out that principle in connection with requirements of the electricity supply department for steel poles and insulators. The *Sydney Daily Telegraph* gives the following list of the amounts of the rival tenders for these goods:—

	Lowest Tender or Quotation.	Lowest British Tenders.
Poles	£910 0 0	£1,166 10 0
Insulators (2,500)	687 10 0	1,562 10 0
	£1,597 10 0	£2,729 0 0

Excess of lowest British tenders over Japanese and American quotations, £1,131 10s.

The lowest tender for disk-strain insulators was 5s. 6d. each, or £687 10s. for 2,500. The committee recommended that the tender of 12s. 6d. each, or £1,562 10s., for Canadian-made insulators, be accepted. Two tenders from American firms were also lower than the Canadian tender. The general manager (Mr. Forbes Mackay), in his report, showed that in this case the Electricity Department was giving a preference, in buying Canadian-made insulators, of over 127 per cent. Ald. Stokes (Labour) failed to a get a seconder to his motion that the Japanese insulators be accepted. The lowest British tender for a number of steel poles was £1,166 10s. The general manager, however, recommended the acceptance of a quotation of £910 for American-made poles, and gave as his reasons that the poles were superior, and the contract not subject to the Council's preferential policy. Again, however, the Committee decided to recommend the lowest British tender, Messrs. Noyes Bros., £1,166 10s. Ald. Lionel Courtenay complained that the Council was performing a function that rightly belonged to the Federal Parliament.

School Installation.—The D.P. Battery Co., Ltd., Bakewell, has just installed one of its latest-type storage batteries at Stowe House, near Buckingham, which has recently been converted from a country mansion to a public school. The battery was supplied through Messrs. Girdlestone & Co., who were responsible for the electrical work.

Instrument Manufacture in Irish Free State.—Mr. J. J. Walsh, Postmaster-General of the Irish Free State, announced in Dail Eireann recently that one of the Government Departments was in communication with a foreign firm with a view to encouraging it to start the manufacture of electrical instruments in Dublin.

The Metric System in Russia.—On September 1st this year, says a Russian journal, the metric system will be introduced in the electrical industry of Russia.

For Sale.—Leeds Corporation electricity department invites offers for two 4,000-b.h.p. steam turbines, alternators, and condensing plant auxiliaries.

By direction of the Disposal and Liquidation Commission, Messrs. Bradshaw, Brown & Co. will sell by auction on June 13th and following days at the Royal Dockyard, Woolwich, S.E.5, wireless material, telephone and electrical equipment, &c. (See our advertisement pages to-day.)

Copper and Lead Prices.—Messrs. F. Smith & Co. report May 22nd:—No change in electrolytic copper prices.

Messrs. James & Shakespeare report, May 22nd:—Copper bars (best selected), sheet and rod, no change; English pig lead, £27 5s., 5s. inc. on last week's price.

Birmingham Electrical Trade.—Our correspondent reports:—"The electrical engineering industry of Birmingham is making steady progress, and many of the firms engaged on accessories are well occupied. A fairly large number of orders has also been received by reason of the extension of public power stations in this country, and a lot of heavy plant is being produced for hydro-electric stations in Australia and New Zealand."

LIGHTING AND POWER NOTES.

Australia.—MELBOURNE (VIC.).—The report of the Electric Supply Committee for the year 1922 records a total revenue of £403,750, as against £356,446 in the previous year. Working expenses totalled £243,626, as compared with £234,655, leaving a gross profit of £160,124 (£121,791). After the payment of capital charges, &c., a net profit of £40,755—an increase of £6,924. A total of 53,846,526 kWh was sold, an increase of 8,581,686 kWh, or 18.9 per cent. The report refers to the visit of the chief engineer (Mr. W. H. Alabaster, M.I.E.E.), to England and America to study the latest methods adopted in these countries. The new schedule of charges, which is very favourable to domestic consumers, is embodied in the report, and reference is made at some length to the position of the Council under the proposals of the State Government to control the distribution and output of electricity. The policy of the Government is that there will be no coercion of the City Council in any scheme which may be formulated. The Council considers that its rights have been affected by the Government's acquisition of the North Melbourne Electric Tramway & Lighting Co.'s undertaking.

NEW SOUTH WALES.—The *Sydney Morning Herald* reported recently that Mr. Forbes Mackay, the city electrical engineer of Melbourne, had submitted a report to the City Council, in which he states that he doubts whether there is a single site in the State at which electricity could be profitably generated by water power. While it might be possible to bring power to the city from the Snowy River, and make an annual coal saving of £100,000, the interest upon the cost of the construction would amount of £150,000 per annum.

The Council is being urged to instruct the engineer to prepare a report upon the steps to be taken to ensure a continuous supply of electricity. The Railway Commissioners, who have an ample margin of power until the electrification of the suburban lines is completed, are affording the city a bulk supply. In the event of this supply ceasing, a new station would have to be brought into use. It is suggested that a coal mine might be bought and the station built near it.

Barnsley.—PRICE REDUCTIONS.—The following price reductions have been made: Lighting: from 7d. to 6d. per kWh. Kinemas and theatres: from 5.35d. to 4½d. per kWh. Heating and cooking: from 1½d. to 1¼d. per kWh. Power: Flat rate and sliding scale by ¼d. per kWh. The meter rental of 1s. 6d. is to be abolished.

Bedford.—SPECIAL ORDER.—The Town Council has applied to the Electricity Commissioners for a Special Order for authority to extend its area of supply so as to include the Urban District of Kempston and certain parts of the Rural Districts of Bedford and Biggleswade.

Canada.—HYDRO-ELECTRIC DEVELOPMENT.—The Northern Canada Power Group has obtained a lease for sixty years of the Nakake Falls on the Upper Ottawa River for generating electricity. A power station is to be erected with an estimated capacity of 60,000 h.p., and it is hoped to have it completed by the summer of 1924. Electrical energy will be supplied to the Porcupine mining district, Northern Ontario, and a transmission line 65 miles in length is to be erected.—*Reuter's Trade Service* (Ottawa).

SUPPLY STATISTICS.—According to a report just received by the High Commissioner for Canada in London from the Dominion Bureau of Statistics at Ottawa, central electric stations in the Dominion generated for sale and distributed during 1921 an aggregate of 5,614,132,000 kWh, at an average charge to the consumer of slightly over three-quarters of a cent. per kWh. Over 97 per cent. of this electrical energy was generated by water power, and the hydraulic stations sold their output at still lower rates than the average recorded above. In Ontario the average revenue per kWh was .582 cents; in Quebec it was .850 cents; in British Columbia, .787 cents; and in Manitoba, 1.018 cents. In the Provinces named almost the whole of the electricity was generated by water-power, steam-power being utilised chiefly in the coal-producing districts of Canada, or in auxiliary plants elsewhere. The total amount of capital employed in the central electric stations of Canada on December 31st, 1921, was $484,669,451, representing an increase of 8 per cent. during the year. Revenues increased in 1921 by 12 per cent., aggregating $73,376,580, while operating expenses increased only 4 per cent. The number of employés was 10,714, the total pay roll amounting to $15,234,678. The total number of central electric stations in Canada in 1921 was 857, of which 259 were hydraulic and 251 were fuel stations. There were also 347 non-generating stations. Water-wheels and turbines numbered 604, of a total horse-power of 1,826,357; steam reciprocating engines totalled 187, their power aggregating 45,450 h.p., and there were 43 steam turbines of 90,705 h.p.; gas and oil engines used for electricity supply numbered 203, of 15,345 h.p.

Cheadle and Gatley.—LOAN.—The Urban Council has applied to the Electricity Commissioners for sanction to a loan of £5,685 in connection with the supply of electricity in the Finney Lane and Heald Green districts.

Continental.—RUSSIA.—In January last the h.p. line from the Elektroperedatch station to the Burnoff sub-station was inaugurated. Since then a similar line—about eight miles in length, has been added between the Burnoff sub-station and the Gorodischtchensk factory, making about 35 miles in all. This is the initial section of the ring that is to proceed from Gorodischtch to Schtecholkoff, Bolschevo, Huitischtchi, Balaschicha, Reyutovo, Savino, and Kudinoff.

AUSTRIA.—The U.S. Consul in Vienna reports that during 1922 ten hydro-electric stations of more than 500 h.p. each, and having a total capacity of 22,610 h.p., were completed and put into operation. Eight additional stations, with an aggregate capacity of 33,030 h.p., were commenced, and, in addition, some work was done in 895 undertakings of less than 500 h.p. each.

Crowborough.—INAUGURATION OF NEW PLANT.—The Hon. Osmund Scott, on May 16th, opened for public service the new electrical plant at the Crowborough Gas Works. Powers for this supply were originally obtained in 1913, but the war prevented development. In 1916 the Electricity Commissioners extended the powers, and the Crowborough District Gas Company, calling in Sir Charles Bright & Partners, Ltd., as consulting engineers, has carried out a lighting and power scheme pre-eminently suitable for its scattered area. Sir Charles Bright, in the course of a speech, said there were great economic advantages to be obtained by producing both gas and electricity on the same site and with the same staff. When future development made electric heating economical, he was sure that the Crowborough Gas Company would be ready to meet the demand, but in the meantime he felt that gas would still be largely used for heating. The plant has cost £6,000, with £4,000 for three miles of mains. Current is supplied at 240 volts to consumers, and at 2,400 V on the transmission lines, single-phase at 50 periods. The main contractors for the plant and switchboard were Messrs. Crompton and Co., Ltd. The 100-kW engine is of the multi-cylinder, medium speed, horizontal type, manufactured by the Premier Gas Engine Co., and the smaller engine is a Crossley twin-cylinder horizontal engine. There is a Taylor-Scotson automatic voltage regulator, supplied by Messrs. Cox-Walkers, Ltd., of Darlington. The engines are driven by town gas, and the pumping equipment for the cylinder cooling water is worked in conjunction with the general works pumping requirements. The whole of the erection and installation of the new plant has been carried out under the supervision of Mr. A. G. Cheal, who is the engineer, secretary, and manager of the company.

Devizes.—OPPOSITION WITHDRAWN.—The Urban District Council has withdrawn its opposition to the application of the Western Electric Distributing Corporation, Ltd., for a Special Order to supply electricity to a number of towns in West Wilts., including Devizes.

Dover.—ELECTRICITY CHARGES.—The Electricity Commissioners have fixed the maximum price of electricity at 8½d. per kWh, as from July 1st, instead of 9d. per kWh, as from September 1st. A sub-committee has been formed to negotiate terms for a bulk supply of electricity applied for by a private firm at Deal.

Evesham.—ELECTRICITY SUPPLY.—With regard to the application of the Shropshire, Worcestershire, and Staffordshire Electric Power Co. for an Order to supply electricity in the district, the Town Council has come to an agreement with the company whereby it will retain its power to purchase the undertaking at the end of the statutory period, and has therefore withdrawn its opposition to the application.

Featherstone.—ELECTRICITY SUPPLY.—The Urban Council has sealed an agreement with the Electrical Distribution of Yorkshire, Ltd., for a supply of electricity for public lighting by September 1st next.

Harpenden.—ELECTRICITY SUPPLY.—The Urban Council has sealed an agreement with the North Metropolitan Electric Power Supply Co., authorising the company to supply electricity within the urban district.

Hove.—INQUIRY.—The Electricity Commissioners are to hold an inquiry on May 29th into the Town Council's proposal to purchase the Vallance estate for the erection of a sub-station.

Japan.—TAIWAN ELECTRIC POWER CO.—It is reported that the Japanese Government has decided to provide the Taiwan Electric Power Co. with funds to enable it to continue construction of the generating plant, on which work has been temporarily suspended. The original plans were for the construction of a power plant of 100,000-kW capacity, to cost 40,000,000 yen. These plans have been modified to some degree, it being now estimated that the total amount of capital required will be 30,000,000 yen.—*Commerce Reports.*

Kettering.—SPECIAL ORDER.—The Urban District Council is applying to the Electricity Commissioners for a Special Order, authorising it to supply electricity within the Urban Districts of Market Harborough, Desborough and Rothwell, and certain parishes in the Rural Districts of Kettering, Market Harborough, Oxenden and Wellingborough.

London.—BATTERSEA.—Upon the advice of the Electrical Engineer, the Electricity Undertaking Committee recommends the laying of cables, at a cost of £1,107, to give additional supplies in the Nine Elms district; and also to install a new rotary feed pump, with a capacity of 10,000 gallons per hour, at a cost of £585.

New Mill (Yorks.).—SPECIAL ORDER.—The Urban District Council is applying to the Electricity Commissioners for a Special Order, authorising it to supply electricity in the district. A consulting engineer is to be appointed to prepare a scheme.

New Zealand.—OTAGO.—The Provisional Electrification Committee, Dunedin, has adopted a report presented by its engineer (Mr. A. P. Aldridge) for a district power scheme. Power will be supplied from Port Chalmers to Palmerston, and the whole scheme is estimated to cost £150,000.—*Reuter's Trade Service* (Melbourne).

Norwich.—LOAN.—The Corporation is applying to the Electricity Commissioners for sanction to the borrowing of £34,000 for mains and services.

Poulton-le-Fylde.—ELECTRICITY SUPPLY.—The Urban District Council has appointed a deputation to negotiate with the Blackpool Corporation for a supply of electricity to the district.

Preston.—PROPOSED CHANGE-OVER.—The Corporation is applying to the Electricity Commissioners for permission to alter its system of electricity supply. The existing supply is

given at 440 and 220 V, d.c. and 220 V, a.c., single-phase, 50 periods. It is proposed that the supply shall be given as follows: (1) d.c. at 440 and 220 V; or (2) a.c., single-phase, 50 periods, at either 220 or 240 V; or (3) a.c., 3-phase, 50 periods, at 416 V.

Shrewsbury.—Loan.—The Town Council has applied to the Electricity Commissioners for sanction to the borrowing of £10,000 for the extension of the electricity undertaking.

South Africa.—New Power Station.—The Victoria Falls and Transvaal Power Co. has decided to erect a large power station near the Witbank station. Three generating sets, each with a capacity of 20,000 h.p., are to be installed. The estimated cost of carrying out the scheme is £1,000,000, and it is anticipated that the station will be ready for operation in 1925.

Swansea.—Year's Working.—The accounts of the electricity undertaking for the year ended March 31st last show a total revenue of £119,834, as compared with £104,629 in the previous year. Working expenses amounted to £62,820 (£69,603) leaving a gross profit of £57,014. After deducting capital charges, &c., there was a net profit of £19,365. In the previous year there was a surplus of £3,422. The Electricity Committee has recommended that £13,000 be transferred to reserve and the surplus to the relief of the rates. The number of kWh sold rose from 9¾ millions to over 14 millions.

Tiverton.—Electricity Scheme.—The Town Council has adopted an electric lighting scheme prepared by Mr. Christy, and has applied to the Electricity Commissioners for sanction to erect a generating station at the gas works. The estimated cost of the scheme is £17,800.

United States.—Hydro-Electric Development.—According to *Power*, the Penn Public Service Corporation has in hand a scheme for erecting three hydro-electric power stations on the Clarion River. A contract has been placed with the Westinghouse Electric and Manufacturing Co. for two 12,000-kVA vertical water-wheel generators for the power station at Piney Creek, which will be the first of the three stations to be put in operation. This order represents one-half of the plant which will ultimately be installed. When the three stations are completed they will have a total capacity of 262,000 h.p. The estimated cost of carrying out the scheme is $28,000,000. It is proposed to supply electrical energy for industrial purposes in North and North-Western Pennsylvania and Eastern Ohio.

Wokingham.—Electricity Order.—The Rural Council has consented to an application by the Thames Valley Electric Supply Co., Ltd., for an Order to supply electricity to all the parishes in the Council's area, with the exception of Wokingham Without and Finchampstead. The maximum charge is 1s. per kWh.

Wolverhampton.—Loan.—The Town Council is applying to the Electricity Commissioners for sanction to the borrowing of £2,650 for mains and sub-station equipment.

Worcester.—Special Order.—The Corporation has applied to the Electricity Commissioners for a Special Order authorising it to extend its area of supply so as to include certain parts of the rural districts of Droitwich, Martley, Upton-to-Severn and Pershore.

TRAMWAY AND RAILWAY NOTES.

Continental.—France.—M. le Trocquer, Minister of Public Works, has approved the first section of the programme for the electrification of the Orleans and Midi railway systems. For the Midi railway, the programme from 1923 to 1927 affects 1,576 km., and includes, in addition to the line from Toulouse to Dax, with a branch serving the Pyrenees, the line from Bordeaux to Irun and its branch lines to Le Verdon, Arcachon, Biarritz, Puyo, Mauleon, Saint Palais, St. Jean Pied de Port, and St. Etienne de Baigorry; the extension of the trans-Pyrenean lines to Pau and Laruns, Portet-Saint Simon and Boussens, and several lines to the north of the Toulouse-Dax line. The first section of the Orleans line to be electrified will be the section from Paris to Brive, with the Bretigny-Dourdan branch line and the lines from St. Sulpice Lauriere to Gannat and Brive to Clermont, making a total distance of 916 km.—*Reuter's Trade Service* (Paris).

Spain.—The transport workers' strike appears to be spreading, and a number of workers in other branches are coming out in sympathy. At Toledo the electricians have come out on strike, and the town is in darkness. A detonator was exploded near the house of a factory manager, causing damage. Some arrests have been made.—*Reuter* (Barcelona).

Japan.—Railway Electrification.—The Imperial Department of Railways has decided to proceed with the construction of the Tokaido electric railway. The estimated cost of carrying out the scheme is 31,726,500 yen, and it will be completed by the 1928-29 fiscal year.—*Board of Trade Journal.*

The Musashino Railway of Japan has placed an order with the Westinghouse Electric and Manufacturing Co. for three electric locomotives, two motor-car equipments, and two trailer-car equipments. Each locomotive will be equipped with four Westinghouse 100-h.p. motors geared direct to the driving axles and will weigh 33 tons. The mechanical parts for the locomotives will be furnished by the Baldwin Locomotive Works. The Musashino Railway will operate these new equipments from Ikebukuro, situated about 10 miles north-west of Tokio, west to Han-no, a distance of 27 miles. This road is a narrow-gauge (42 in.) system operating on 1,200-V direct current drawn from an overhead trolley wire.—*Railway Review.*

Leeds.—Year's Working.—The accounts of the Corporation tramway undertaking for the year 1922-23 show a total revenue of £961,507, as compared with £959,703 in the previous year. The working expenditure amounted to £599,983, as against £702,250, leaving a gross profit of £361,524, to which was added interest on investments, &c., £20,714, making a total of £382,238 available to meet capital charges, as compared with £276,059 in 1921-22. These and other charges, including £105,653 for track renewals, absorbed £290,747; the result was thus a net profit of £91,491. In the preceding year there was a deficit of £43,266.

The number of passengers carried increased from 129,707,972 to 134,926,024, and the number of car-miles run from 9,326,755 to 9,875,548. The receipts per car-mile fell from 24.695d. to 23.267d.

London.—Underground Station to Close.—The Kennington station of the City and South London Railway is to be closed on and from June 1st in order to expedite the reconstruction work which is proceeding between Moorgate and Clapham Common.

Fire.—A fire broke out on May 16th in the stores at the Clapham Common station of the City and South London Railway. It originated among some cotton waste, and considerable damage was done.

TELEGRAPH & TELEPHONE NOTES

Automatic Telephones at Glasgow.—A Corporation Installation.—The Glasgow Corporation Electricity Department formally inaugurated last week a system of rotary automatic telephones, designed to afford intercommunication between the various branches of the department. The apparatus has been installed by the Western Electric Co. Lord Provost Paxton "put through" the first call, and an explanation of the new method of "calling up"—the first of its kind in Scotland and the second in Great Britain—was given by Mr. R. B. Mitchell, the chief engineer.—*Glasgow Evening News.*

Latvia.—Automatic Telephony.—A new full-automatic telephone exchange, to replace the present system in operation in Riga, has been proposed by the General Director of the Latvian Post and Telegraph Bureau of the Ministry of Communication. The Cabinet is reported to have approved the project in March last, which will be submitted to the Constituent Assembly this summer. The project calls for a machine-switching telephone exchange of 10,000 lines, with a maximum capacity of 20,000 lines. The installation will be extended over a period of about four years. The estimated cost is stated to be $600,000. The present exchange has a capacity of 10,000 lines, of which only 5,000 are used in local service and 1,500 in long-distance service, leaving 2,000 lines free. It is estimated that the net earnings of the telephone system for the year 1923 will reach about 4,000,000 roubles, or $15,000.—*Commerce Reports.*

RADIO-TELEGRAPHY AND TELEPHONY.

Australia.—Broadcasting.—Many applications for licences to broadcast by radio-telephony have been received by the Postmaster-General, but none have been issued, and a good deal of discussion has taken place recently concerning the action of Amalgamated Wireless (Australia), Ltd., in issuing a notification to the effect that it intends to take legal action against any person infringing the patent rights held by it. The wireless movement has of late developed rapidly in Australia, and large numbers of amateur stations exist, from simple crystal receiving outfits to multi-valve long-distance receivers, and also transmitting stations.

The control of wireless in Australia, whether it be from a commercial or experimental point of view, is in the hands of the Controller of Wireless, a Federal official, and the administrator of the Federal Wireless Department. Every station—ship, shore, commercial, or experimental—must be licensed by him. Amateur licences are granted in two broad classes, receiving only and receiving and transmitting. The receiving licence is again divided into two classes, one entitling the owner to use simple crystal apparatus, the other permitting him to use more complicated valve receivers. The latter class of licence is not, however, granted unless qualifications regarding an operating speed are provided. The Controller also has power to issue broadcasting licences. Some of the leading amateurs have had their position defined, and concerts which have been a weekly feature in the past will be conducted as usual. Transmitting licences which are issued by the Controller of wireless allow the holder to experiment in certain directions, but state that transmission must relate to the experiments specified in the application. If an amateur ob-

tains a licence of this description he can hardly expect to be allowed to use it for the indiscriminate broadcasting of speech and music.

Dutch News Agencies at Law.—An action of interest in connection with property rights in news distributed by wireless is now engaging the Dutch Courts. One Dutch news agency sued another for intercepting and sending to its newspaper subscribers news sent to the first agency by wireless by a third agency in Berlin. Each of these messages bore as a prefix a notice that they were the copyright in Holland of the plaintiff agency, which claimed payment at a specified rate for each message thus intercepted and distributed. The President of the Hague Court on May 14th ordered the defendant agency immediately to cease intercepting the wireless messages which the plaintiffs claimed as their property until it has been judicially decided whether such interception is illegal or not, and ordered the defendants, in the former event, to pay 25 florins for each item of news illegally intercepted and distributed.—*Morning Post.*

Greenland. — Radio-Telegraphy.—For some considerable time the Copenhagen authorities have been considering the establishment of a wireless connection with Greenland, and the question has also been discussed whether the installation should be run by a private company or by the Government. A private company offered to run the plant, subject to the grant of an annual subsidy of Kr 200,000, owing to which proposal the matter has been dropped. The Government has also received an offer from the Dansk Radio interests, which are ready to erect at their own expense the necessary plant and to run the station experimentally for a year; after that period should the Government not be satisfied with the arrangement it would lapse immediately. This proposal has been submitted to the Finance Committee.—*Financier.*

Radio-Broadcasting.—At the request of many of its member firms, the Industrial Welfare Society has approached the British Broadcasting Co. with a view to securing a change in the time of transmission of the mid-day concert, in order that industrial workers may have the opportunity of "listening-in" during their normal dinner hour. Many workers take their mid-day meals in canteens and mess-rooms provided by their employers, and we understand that many firms are willing to install receiving apparatus if the time of the mid-day transmission is re-arranged.

A radio concert was arranged as a test by the local municipal council in Southall Park (West London) last week. A similar experiment was recently conducted at Sefton Park (Liverpool) with wireless music as an alternative to ordinary band music. Within 300 yards from the trumpet, the music was clearly audible.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared in our advertisement pages.)*

OPEN.

Aberdare.—June 7th. Electricity and Tramways Department. One 3-ton end-tipping electric lorry and a motor-generator charging set and control gear. (May 18th.)

Australia.—Melbourne.—August 25th. Electricity Commissioners. 31 22,000-V transformers ranging from 750 to 15 kVA.

August 31st. Electricity Commissioners. Aluminium steel-cored cable. (See this issue.)

Newcastle (N.S.W.).—July 26th. City Council. H.p. switch and control gear, &c., for the electricity works.

Sydney.—November 19th. City Council. Storage batteries, regulating switches, copper connections, charging boosters, and switchgear (spec. 736). Spec. (21s.) from the City Treasury, Town Hall, Sydney.

July 2nd. Vacuum tungsten and carbon-filament electric lamps.—*Reuter's Trade Service* (Melbourne).

Belgium.—May 30th. Belgian State Railway authorities (Office de l'Electricité), 25, Rue de la Charité, Brussels. 10,000 carbon-filament and 40,000 metal-filament lamps.

June 8th. The municipal authorities of Zolder (Province of Limburg). Establishment of a l.p. electricity distribution system in the town.

Blackpool.—May 30th. Electricity Committee. One water-tube boiler, complete with stoker and auxiliaries. (May 18th.)

Crook.—June 4th. Urban District Council. Pole line, transformers, and switchgear in connection with the electric lighting scheme. (May 11th.)

Croydon.—June 6th. Electricity Department. Coal (approx. 4,000 tons). (See this issue.)

Dublin.—June 5th. Dublin United Tramways Co. (1896), Ltd. Stores for six months (including electric lamps, fittings, &c.). (See this issue.)

Falkirk.—Electricity Department. One 2,000-kW turbo-alternator, with condensing plant and accessories. (May 18th.)

India.—Bombay.—June 28th. Great Indian Peninsular Railway Co. Electrification of Bombay suburban lines. Motor bogie trucks and bonds. (May 18th.)

Leicester.—June 23rd. Electricity Department. One 12,500-kW, 3-phase turbo-alternator, with condensing plant, and one 500-kW house service turbo-alternator. (See this issue.)

London.—Islington.—May 30th. Electricity Department. Plant for raising water from artesian well by compressed air lift, water-treating plant, h.p. and l.p. switchgear for sub-stations. (May 11th.)

L.C.C.—June 11th. L.p. electric cables (including telephone and pilot cables) and relaying and jointing existing l.p. cables. (May 18th.)

Fulham.—May 26th. Electricity Department. Six 200-kW air-cooled transformers. (May 18th.)

India Store Department.—June 8th. Electric cables. (May 18th.)

June 15th. V.i.r. copper wire. (See this issue.)

Newcastle-on-Tyne.—May 30th. Trade and Commerce Committee. One 5-ton and two 2-ton electric travelling gantry cranes. Specifications from the office of the city engineer, Town Hall, Newcastle-on-Tyne.

June 8th. Electricity Department. One 500-kW rotary converter, with e.h.p. and l.p. switchgear. (See this issue.)

Newmill, Huddersfield. — May 31st. Urban District Council. Three-phase, 400-V switchboard, &c., 230 creosoted wood poles, 1,500 insulators, iron and wood arms, h.d. bare copper conductor, labour and erection. (May 18th.)

Rumania. — June 1st. The Department of Overseas Trade is informed that a Rumanian municipality intends to place an order for one 600-h.p. Diesel engine and dynamo (220 V, d.c.), including cost of installation.*

South Africa.—Pretoria.—June 27th. Irrigation Department. 50-h.p. hydro-electric plant for the Hartebeestpoost irrigation works.*

Riversdale (Cape Province).—July 31st. Municipal Council. Generating plant, l.p. distribution material, meters, &c.*

Johannesburg.—June 4th. Municipal Council. Electric wire and cable and transformers.*

Southampton.—May 26th. Electricity Department. One 5,000-kW (or alt. 6,000 kW) turbo-alternator, with condensing plant and accessories. (See this issue.)

Spain.—Madrid.—June 5th. General Post Office. Telephone materials, carbons, &c. Tenders from British firms will be considered only in respect of such material as is not manufactured in Spain.*

June 12th. Direccion General de Correos y Telégrafos (Seccion de Telégrafos). Galvanised iron wire for the telegraphic and telephonic systems:—30 tons, 4 mm.; 30 tons, 3 mm.; 20 tons, 2 mm.—*Reuter's Trade Service* (Madrid).

July 2nd. Direccion General de Obras Públicas, Ministerio de Fomento, Madrid. Electric locomotives and installation of cable for the line from Ripoll to Ax-les-Thermes, one of the trans-Pyrennean lines now being constructed.—*Reuter's Trade Service* (Madrid).

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

CLOSED.

Aberystwyth.—Town Council. Accepted. In connection with the new sewerage outfall works:—

Electrically-driven pumping plant (£905).—Boving Engineering Works, Ltd. Electrically-driven sewage screens and raking apparatus (£838).—S. S. Stott & Co., Ltd.

Australia.—Melbourne.—Victorian State Rivers and Water Supply Commission. Accepted:—

Electric generating set for Redcliffs (£7,896) and two water-tube boilers for Millews pumping plant (£3,398).—Thompson & Co., Ltd., of Castlemaine, Vic.—*Reuter's Trade Service* (Melbourne).

Mackay (Queensland).—City Council. The General Machinery and Electrical Co., Ltd., Brisbane, has been notified by the Mackay City Council, Queensland, of the acceptance of its quotation for the following plant:—Engines, by Bellias and Morcom; and alternators, transformers, switchgear, and lightning arresters, manufactured by the English Electric Co., Ltd., London.—*Tenders.*

Ayr.—Town Council. Accepted:—

Cable in connection with the supply of electricity to Milne's ice factory and other consumers in the Tam's Brig area (£2,364).—Callender's Cable & Construction Co., Ltd.

London.—L.C.C.—The Council has renewed the contract with the Siemens and English Electric Lamp Co., Ltd., for the supply of the whole of its requirements of electric incandescent lamps, including gasfilled, vacuum-type, and carbon-filament lamps, for a further period of 12 months. The same company has also secured a contract from the Port of London authority for the supply of Siemens' gasfilled-type lamps.

London Electric Railways.—The Westinghouse Brake and Saxby Signal Co., Ltd., of London and Chippenham, has received orders for Westinghouse brake equipments for 150 new coaches for the London electric railways.

Salford.—Town Council. Accepted:—
Two electrically-driven centrifugal pumps (£607).—Mather & Platt, Ltd.
Two electrically-driven reciprocating pumps (£1,473).—Tangyes, Ltd.

Southend-on-Sea.—Town Council. Accepted:—
One 750-kW engine and spares and three complete sets of pistons and cylinders (£3,380).—Hicks-Diesel Oil Engine Co.

Wicklow (Ireland).—The Urban District Council has placed the contract for the electric lighting scheme with Mr. J. Kane, of Wicklow.

Government Contracts.—The following Government contracts were placed during April, 1923:—

ADMIRALTY CONTRACT AND PURCHASE DEPARTMENT.
Battery spare parts.—Tudor Accumulator Co., Ltd.
Batteries, &c.—Hart Accumulator Co., Ltd.
Condensers.—Dubilier Condenser Co. (1921), Ltd.
Electric travelling crane.—Sir W. Arrol & Co., Ltd.
Electric battery components.—Chloride Electrical Storage Co., Ltd.
Electrodes.—Quasi-Arc Co., Ltd.
Motor alternator, field regulators, and spares.—Newton Bros. (Derby), Ltd.
Plate groups for submarine batteries.—Chloride Electrical Storage Co., Ltd.
Parts for turbines.—Yarrow & Co., Ltd.

WAR OFFICE.
Sheet copper.—Chas. Clifford & Son, Ltd.
W.t. valves.—A. C. Cossor, Ltd.; General Electric Co., Ltd.; Mullard Radio Valve Co., Ltd.
Electric wire.—Callender's Cable & Construction Co., Ltd.

AIR MINISTRY.
Motors and reduction gears.—Veritys, Ltd.
W.t.-type valves.—General Electric Co., Ltd.

CROWN AGENTS FOR THE COLONIES.
Electric motors.—Laurence Scott & Co., Ltd.
Spares for Diesel engine.—English Electric Co., Ltd.
Steel poles.—Siemens Bros. & Co., Ltd.
Telephones.—Western Electric Co., Ltd.

POST OFFICE.
Telephone apparatus.—British L. M. Ericsson Manufacturing Co., Ltd.; General Electric Co., Ltd. (Peel-Conner Telephone Works); Siemens Bros. & Co., Ltd.; Sterling Telephone and Electric Co., Ltd.; Western Electric Co., Ltd.
Testing, protective apparatus.—Phœnix Telephone and Electric Works, Ltd.; H. W. Sullivan, Ltd.; E. Turner.
Battery boxes.—British L. M. Ericsson Manufacturing Co., Ltd.; Siemens Bros. & Co., Ltd.
Coin collecting boxes.—Hall Telephone Accessories, Ltd.
Telegraph and telephone cable.—Callender's Cable & Construction Co., Ltd.; Connollys (Blackley), Ltd.; Enfield Ediswan Cable Works, Ltd.; Siemens Bros. & Co., Ltd.; Western Electric Co., Ltd.
Joint box castings.—United Steel Companies, Ltd. (T. Butlin & Co. Branch); Willesden Foundry, Ltd.
Loading coils.—Western Electric Co., Ltd.
Cable drums.—British Insulated & Helsby Cables, Ltd.; Smith, Partrey and Co., Ltd.
Ducts.—Albion Clay Co., Ltd.; Hepworth Iron Co., Ltd.
Insulators.—Litholite Insulators, Ltd.; Taylor, Tunnicliffe & Co., Ltd.
Glass Leclanché jars.—Bagley & Co., Ltd.
Stoneware ditto.—J. Bourne & Son, Ltd.
Telephone mouthpieces.—North British Rubber Co., Ltd.; Siemens Bros. and Co., Ltd.
Tinfoiled condenser paper.—Brittains, Ltd.
Earth plates.—G. Farmiloe & Sons, Ltd.
Distribution cable plugs.—British Insulated & Helsby Cables, Ltd.
Thermionic valves.—General Electric Co., Ltd.
Bronze wire.—T. Bolton & Sons, Ltd.; Elliott's Metal Co., Ltd.; Enfield Ediswan Cable Works, Ltd.; R. Johnson & Nephew, Ltd.; Shropshire Iron Co., Ltd.; F. Smith & Co., incorporated with the London Electric Wire Co. & Smiths, Ltd.
Copper wire.—Elliott's Metal Co., Ltd.; Enfield Ediswan Cable Works, Ltd.; Johnson, Clapham & Morris, Ltd.; Shropshire Iron Co., Ltd.; F. Smith & Co., incorporated with the London Electric Wire Co. and Smiths, Ltd.; Wilkes, Sons & Mapplebeck, Ltd.
Leclanché rod zincs.—Siemens Bros. & Co., Ltd.
Manufacture, supply, drawing-in and jointing of cable.—Settle and Bradford: Western Electric Co., Ltd. Glasgow-Kirkintilloch-Kilsyth; Kilmarnock-Ayr and Troon: Johnson & Phillips, Ltd.
Electric lighting Post Office Savings Bank extension.—G. E. Taylor and Co., Ltd.
Steel wireless masts, Imperial Wireless Stations, England.—Head, Wrightson & Co., Ltd.
Telephone exchange equipment.—Sheffield (Central), Attercliffe, Owlerton, Broomhill: Siemens Bros. & Co., Ltd. Sub-contractors for accumulators: Chloride Electrical Storage Co., Ltd.; for charging machines: English Electric Co., Ltd.; for ringing machines: Crompton & Co., Ltd. Putney, Wimbledon, and Streatham: Siemens Bros. & Co., Ltd. Birmingham (North): Western Electric Co., Ltd. Bradford: Western Electric Co., Ltd. Streatham: Western Electric Co., Ltd. Birmingham (South): General Electric Co., Ltd. Smethwick: British L. M. Ericsson Manufacturing Co., Ltd. York: Automatic Telephone Manufacturing Co., Ltd. Sub-contractors for accumulators: Chloride Electrical Storage Co., Ltd.; for charging machines: Newton Bros. (Derby), Ltd.; for ringing machines: Crompton & Co., Ltd. Shrewsbury: Automatic Telephone Manufacturing Co., Ltd. Sub-contractors for accumulators: Premier Accumulator Co. (1921), Ltd.; for charging machines: Newton Bros. (Derby), Ltd.; for ringing machines: Crompton & Co., Ltd.
Telephone repeater station equipment.—Marlborough, Taplow: General Electric Co., Ltd.

H.M. OFFICE OF WORKS.
Engineering services.—Wiring Natural History Museum: T. Clarke & Co., Ltd.

H.M. STATIONERY OFFICE.
Arc lamps.—Hunters, Ltd.

FORTHCOMING EVENTS.

Faraday Society.—Monday, May 28th. At the Institution of Electrical Engineers, Victoria Embankment, W.C.2. At 3 p.m. General discussion on "The Physical Chemistry of the Photographic Process." Introductory Address by Prof. W. Bancroft on "The Theory of Photography."

Institution of Electrical Engineers.—Thursday, May 31st. At the Institution, Victoria Embankment, W.C.2. At 6 p.m. Annual meeting.

(Western Centre).—Plymouth. June 1st-4th. Summer meeting.

Royal Institution of Great Britain.—Friday, June 1st. At Albemarle Street, W. At 9 p.m. Lecture on "The Radiation of Light," by Prof. H. A. Lorentz.

NOTES.

Automatic Train Control.—Now that the railway companies are settling down to co-operative improvement, one of the most important matters under discussion is the automatic control of trains. All the railway groups have their favoured schemes of control. They are now seeking to combine their ideas, and the general and signal engineers of the groups have twice met and discussed how one working scheme for the whole of Great Britain can be evolved from the various existing experiments.—*Evening News.*

The Fixation of Nitrogen in the United States.—According to the *Electrical World*, the U.S.A. Department of Commerce is taking steps to free American consumers from the domination of the Chilean nitrate producers by instituting an investigation into the methods of fixing atmospheric nitrogen. If private enterprise cannot be induced to undertake the manufacture of nitrates, probably the Government will carry out large-scale experiments. The inquiry will be under the direction of Mr. H. A. Curtis, chemical engineer, assisted by Mr. W. H. Walker.

The Leeds Tramway Accident.—On May 15th, an inquest into the deaths of six persons in the tramcar accident, reported in our last issue, was opened by the Leeds City Coroner. Ald. R. A. Smithson, chairman of the Tramway Committee, and Mr. J. B. Hamilton, general manager of the system, were among those who attended. The former expressed the Tramway Committee's regret at the occurrence, and offered condolences to the relatives of those who were killed. The driver of the car was unable to give evidence, but a police-constable stated that the car appeared from marks on the track to have left the metals for a distance of 105 ft., regaining the track before it finally overturned. Witnesses testified to the efforts made by the driver and others to apply the brakes and stop the car, and passengers stated that the brake appeared to have no effect. Other evidence brought out the fact that the driver left the car before it collided with the wall and overturned, and it was said that he stated that he was thrown off the car.

Upon the Coroner's learning that the Ministry of Transport inquiry was to be commenced the following day (Wednesday) he adjourned the inquest until June 6th.

Lt.-Col. Mount, R.E., opened the Ministry of Transport inquiry on May 16th. The chairman of the Highways Committee stated that a speed limit of four miles per hour had been fixed for Churwell Hill, but this was often exceeded. Witness also stated that, in his Committee's opinion, conductors should be trained to apply the brakes in an emergency; they should not be allowed to leave the platform to collect fares while descending three specified gradients; all cars should have speed-indicating apparatus; and every car should be provided with a jack. Mr. J. B. Hamilton (tramway manager) said that these observations had little bearing upon the subject of the inquiry—the Churwell Hill accident. He considered that the speed limit was observed by drivers. The Inspector said that the Highways Committee's observations would be noted. Another witness said that there was no evidence that sand had been used, although it was available. Further evidence showed that new brake blocks had been fitted to the car recently, and they were not worn much.

Another driver, giving evidence as to speed, said that he never exceeded six miles per hour, and the Inspector held that this showed that the limit was exceeded. The foreman of the Chapeltown depôt said that the car had been inspected and found satisfactory upon the day of the accident. The inquiry was adjourned until the following day.

At the re-opening of the proceedings, the number of casualties was given as seven deaths, eight persons seriously injured, and forty cases of minor injuries. Evidence went to show that no complaint had been received regarding the car's equipment except that the brake "worked hard" on occasions, which was a common occurrence.

After eliciting further evidence regarding the speed of the car, the Inspector adjourned the inquiry until the driver and conductor were fit to give evidence.

Association of Mining Electrical Engineers.—The closing meeting of the session of the Association of Mining Electrical Engineers (West of Scotland Branch) was held in Glasgow on May 16th. Mr. Adam Donaldson, of the Mount Vernon Colliery Co., read a paper on the subject of the layout of colliery switchgear, with special reference to the requirements of the Mines Acts in regard to safety and efficiency. The paper was illustrated by a number of lantern slides. Intimation was made of the arrangements for the annual meeting of the Association of Mining Electrical Engineers, which will be held in Glasgow from June 27th to 30th inclusive. The West of Scotland Branch of the Association, it was stated, has arranged a number of attractive tours to places of interest, and visits to public works and collieries in the district.

(*Continued on page 824.*)

THE BIRMINGHAM CORPORATION ELECTRICITY UNDERTAKING.

The New Nechells Generating Station.

It will be recalled that prior to the commencement of the European war the City of Birmingham commenced the construction of a large new electricity generating station in 1914 on the outskirts of the city at Nechells. The outbreak of hostilities, however, temporarily suspended the operations, but the demand for electricity in connection with the production of munitions of war, in addition to normal requirements, became so insistent that a temporary station had to be hastily erected adjacent to the site of the permanent station in order to meet it. The temporary station is in reality two distinct stations adjoining one another, the first containing two 5,000-kW and the second two 6,000-kW turbo-generating sets; it was described in our issue of March 7th, 1919, and the fact is worth recalling that it was planned, erected, and placed in commission within a period of nine months.

Fig. 1.—Nechells Generating Station.

At a later date the erection of the station with which we are now concerned was proceeded with, and although it is far from complete as yet, the first portion of the plant installed has been in operation for about a year, and the Prince of Wales is to formally open it on June 12th next. Mr. R. A. Chattock, M.I.E.E., city electrical engineer, who was responsible for the design of the station in collaboration with Messrs. C. P. Sparks and Partners, consulting engineers, is to be congratulated on having successfully accomplished a difficult task, notwithstanding the various hindrances that were encountered. That the work executed and that projected is of considerable magnitude is evident from the fact that the new station is designed to have an ultimate capacity of 105,000 kW and will be one of the "super-stations" serving the South-West Midlands Electricity District.

The total capacity of the undertaking is now 95,000 kW, so that the result of the completion of the temporary station and the first portion of the permanent one has been to add about 50,000 kW to the capacity and help make good the deficiency of electricity that had been so acutely felt in Birmingham for several years.

The new station has many noteworthy features, not the least of which are the duplication of most of the auxiliary plant in order to safeguard the continuity of supply, and the use of the effluent from the adjacent sewage farm for condenser cooling purposes. That the staff has been well catered for is shown by the provision of excellent mess and bath rooms, &c., and it is perhaps superfluous to add that the buildings include well-equipped workshops, stores, and office accommodation. The edifice is built upon a reinforced-concrete raft supported by ferro-concrete piles, and the site is well served by the Midland section of the L. M. & S. Railway, and the Birmingham and Warwick Junction Canal. The civil engineering work is of much interest, and is an example of the convenience of reinforced concrete, in connection with which Messrs. L. G. Mouchel & Partners, Ltd., acted as consultants, Messrs. Ewen Harper, Brother & Co. being the architects.

It includes the widening of the canal by 11 ft. to 45 ft.; the provision of railway, road, and foot bridges; a new 1,000-ft. by 32-ft. canal basin, which will eventually have entrance channels at each end terminating in enlarged areas for the manipulation of barges, and having an arm from the southern basin, 24 ft. by 116 ft. 7 in., under the ash hopper; and elaborate railway sidings; the whole of the work was executed from the original ground level, which is several feet below the canal water level, the ground being levelled by filling.

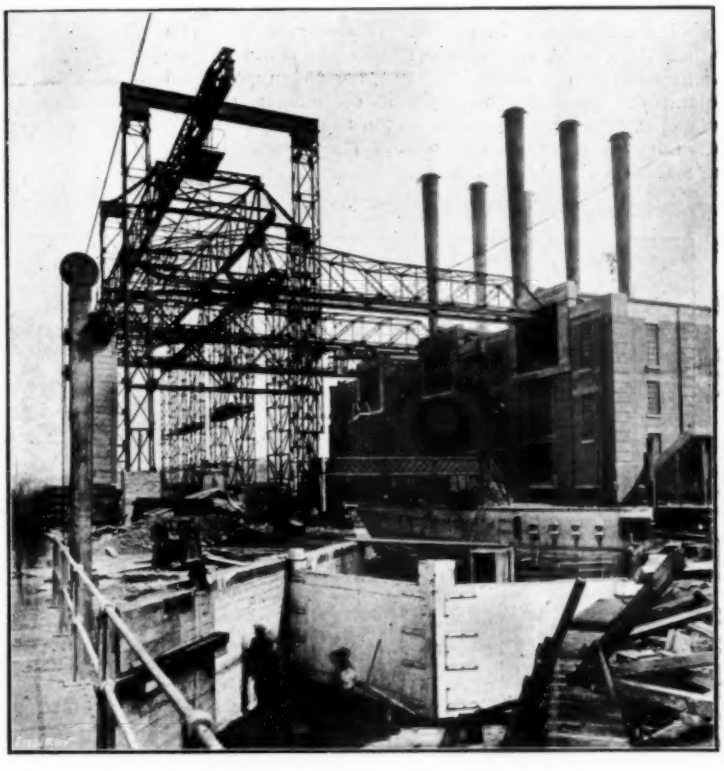

Fig 2.—Coal-Handling Plant.

The area allotted for the bulk storage of coal at the

northern end of the site is shown in fig. 7. A weigh-house and coal transporter will be provided, the latter commanding nearly half the area which will ultimately accommodate some 80,000 tons. The coal and ash-handling plant was supplied by the Mitchell Conveyor and Transporter Co., Ltd., Mr. Chattock having designed the plant with boldness to receive and distribute fuel at the rate of 1,000 tons per day and to deliver it to the bunkers above the boilers at the rate of 100 tons per hour. Railway wagons loaded by the transporter at the main storage depôt are emptied into

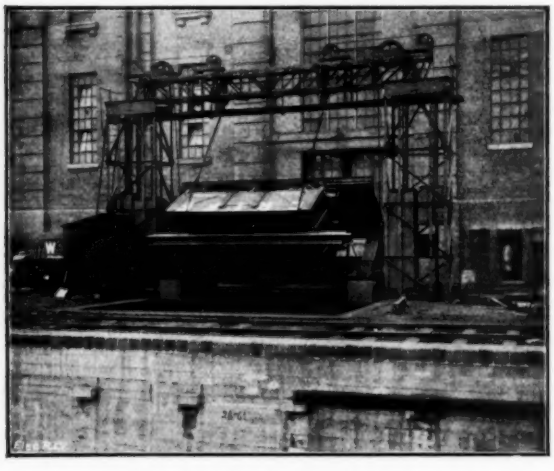

Fig. 3.—Coal Wagon Tippler.

pits by a Mitchell side-discharge tippler, fig. 3, which is almost automatic in action. When a wagon is run upon the cradle, the operator moves a tramway-type controller, which causes the machine to support and clamp the wagon and then tip its contents into a pit; the operator then returns the wagon to its original position by reversing the controller. The capacity of the machine is 120 tons per hour, and the 8-b.h.p. motor driving it only consumes 0.02 kWh per ton of coal handled. For the conveyance of coal to the overhead bunkers either from the auxiliary storage ground between the canal and the new basin, or from barges, or from the tippler pits, provision has been made for an imposing telpher plant, fig. 2, comprising a series of eight elevated gantries with 16 sets of track, although at present only three gantries with six telpher tracks have been completed. The telphers will be capable of delivering to the bunkers of each line of three

Fig. 5.—Ash Hopper.

boilers 40 tons of coal per hour, but normal requirements will only call for the delivery of half this quantity to each line.

The telpher tracks are 50 ft. above ground, and the points, which are controlled from the telpher cabins, are operated through reduction gearing and crank mechanism driven electrically on the block system. The five electric telphers have each a 1-ton grab, each 4-wheel bogie being driven by two motors and the hoist by a 15-b.h.p. motor. The whole of this plant can be worked at the busiest time by five men, one in each car; the energy consumption for conveying coal from the storage ground to the bunkers, including the 50-ft. lift and a 300-ft. travel, is 0.4 kWh per ton handled.

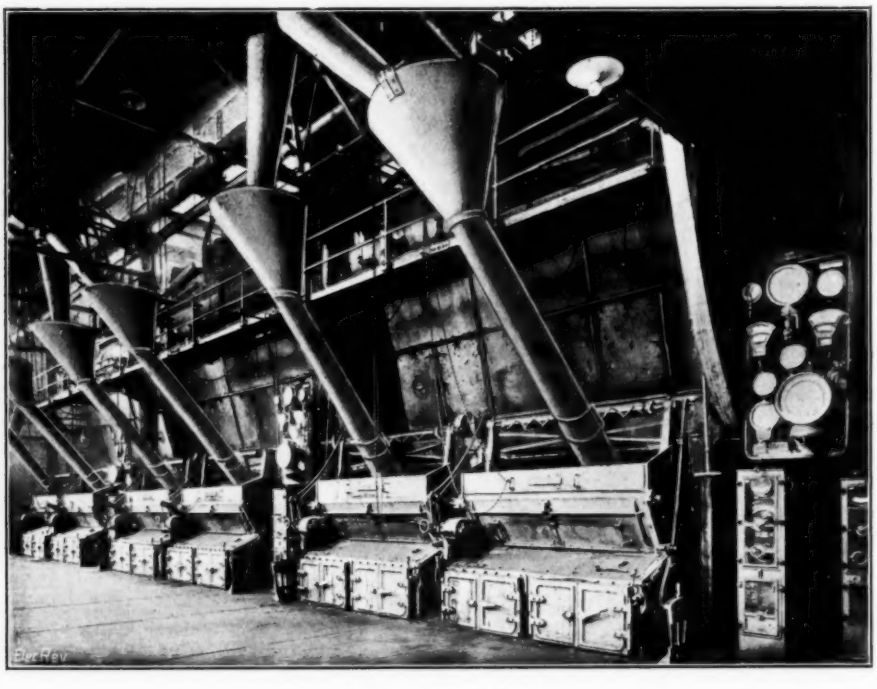

Fig. 4.—Boiler House.

When the boiler house, fig. 4, has been extended to its full length it will contain 42 boilers; the present installation, however, comprises 12 land-type marine water-tube Babcock & Wilcox boilers, each complete with a pair of chain-grate stokers, superheater, and economiser, in groups of three at right angles to the

engine room. Additional boilers are being installed now. The steel chimney and Prat induced-draught fans installed for each pair of back-to-back boilers were supplied by Mr. S. Utting, of Westminster, the heating surface of each boiler being 5,348 sq. ft. and that of the corresponding economiser 3,393 sq. ft. The steam pressure is 320 lb. per sq. in., and its temperature is superheated to 700 deg. F.; the grate area is 224 sq. ft. per boiler, and, when burning coal of a calorific value of 9,000 B.th.u., with a feed temperature of 150 deg. F., each will evaporate 35,000 lb. of water per hour normally, or 42,000 lb. in case of need. With a view to the use of low-grade fuel, most of the boilers operate on the enclosed forced-draught system; the remainder are fitted with three separate compartments per grate between the chains, the ash pit being open, so that air at high velocity can be admitted and the pressure varied as desired at the front, middle, or rear. Induced draught can be used when better-quality fuel is available. The 45-in. double-inlet air fans were supplied by the J. Keith & Blackman Co., Ltd., each being capable of maintaining the air supply to three boilers, which need about 54,000 cu. ft. per minute, the ash-pit pressure being 0.25 in. water gauge. The fans run at 275 r.p.m., with an electrical input of 13.2 kW. A novel feature of the Prat chimneys is that each is fitted with two fans internally on opposite sides. Normally both work together, but one fan is capable of carrying the full load, so that one of the pairs act as a stand-by in addition to the usual stand-by jet. Each fan is driven direct by a 33-b.h.p., pipe-ventilated, d.c., 450-volt motor, the inner bearings being fitted with a Prat air-cooling device—namely, a small auxiliary fan on the induced-draught fan rotor, thus eliminating the usual water-cooling arrangement. A simple device traps the grit.

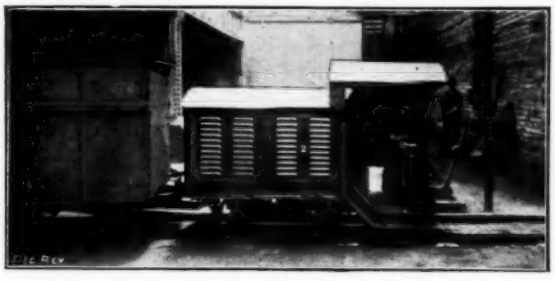

Fig. 6.—Battery Locomotive.

The riddlings (fine ashes) and ash are collected in separate hoppers and discharge into ash-riddling trucks in the basement, which are drawn by two 3-b.h.p., 40-cell battery locomotives, fig. 6, the riddlings being returned to the middle coal bunkers by steam jet elevators, and the 2-ton ash trucks being emptied by a twin hoist, fig. 5, into a reinforced-concrete bunker, whence the ash is discharged into barges or railway trucks. Each winch of the hoist is driven by a 10-b.h.p. motor, and is controlled by push buttons. The ash is water sprayed as it falls into the bunker, which holds 300 tons, and 30 tons of ash can be handled per hour. All the coupling and uncoupling of trucks, ash valve, track point, and hoist manipulation are performed by one man, who also drives the electric locomotive, without leaving the cabin of the latter.

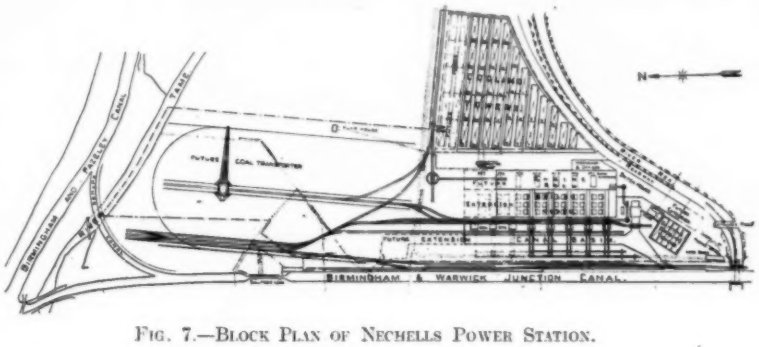

Fig. 7.—Block Plan of Nechells Power Station.

(To be concluded.)

THE BUENOS AYRES WESTERN RAILWAY.

Electrification of the Suburban Lines.

(Concluded from page 782.)

Power and Lighting Equipment.—Two of the traction sub-stations include in their equipment apparatus to supply electricity for general purposes. The Once sub-station deals with the power and lighting requirements of the terminal station, train yard and offices, and gives a supply for pumping in the underground tunnels and for the electric track circuiting. It contains three B.T.H. asynchronous 440-V motors coupled to 125-kW, d.c., 340-V generators and 40-kW, 240-V battery-charging boosters on the same bed plates; the three Berry single-phase, 20,000/400-V, 75-kVA transformers are oil-immersed and naturally cooled. The Chloride battery has a capacity of 1,000 Ah at 240 V.

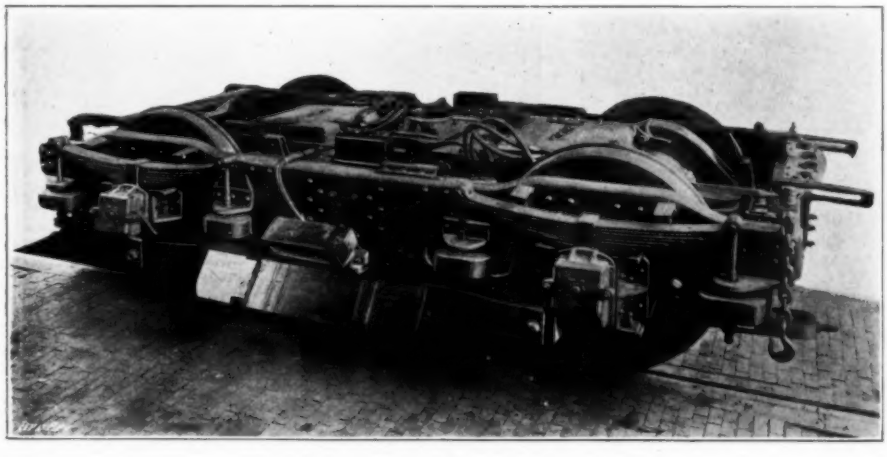

Fig. 16.—Motor Bogie Truck.

At Villa Luro, two B.T.H. 25/50 frequency changers, fig. 10 (900 kVA synchronous motors coupled to 450-V a.c. generators with B.T.H. 3-phase, 20,000/440 transformers) supply power and light to the workshops, car sheds, and repair shops at Liniers. In addition, static sub-stations containing Metropolitan-Vickers 3-phase, 20,000/400/220-V transformers at Caballito, Liniers, and Haedo supply power and light to the shops, yards, and locomotive sheds, while in the case of the supply to the Buenos Aires Great Southern Railway at Kilo. 5 substation, current is transformed in three single-phase Berry transformers from 20,000 to 6,000

Fig. 17.—An 800-V Motor.

volts, at which voltage it is transmitted to Talleres workshops and also to the terminal station at Plaza Constitucion, where it is transformed to 220 and 440 volts for the lighting and power. All static sub-station h.p. and l.p. switchgear is of the Reyrolle ironclad type.

Electrical Equipment of Track.—At the Once terminus the rails are used for track circuiting with a.c. and to permit the use of the same rails as a path for the traction current, impedance bonds are placed at the ends of the track-circuiting sections, consisting of heavy choke

Fig. 18.—Interior of First-class Coach.

coils in oil-filled cast-iron cases placed between the sleepers.

The form of conductor rail, with its protection, is shown in fig. 13 (p. 782). The rails were supplied by the North-Eastern Steel Co. and Messrs. H. J. Skelton and Co., Ltd.; they weigh 86 lb. per sq. yard, are 40 ft. long, and, with the Shaw cast-steel ramps, are covered with lapacho wood boards built up in the shops and fixed in position on the site by hook bolts.

To allow for the wear of the rails into the sleepers, and also the wear of the running rails, the Buller single-shed round porcelain insulators are placed on packing pieces of soft wood and felt, these being removed as required. B. I. & H. anchors are used.

The conductor rail is divided into sections by English Electric 800-volt gear mounted in signal cabins and so arranged that the signalman can quickly isolate any faulty section. Paralleling of the "up" and "down" conductor rails is also provided for in order to make use of their combined conductivity. The switchgear is of the circuit-breaker type, but is automatic or non-automatic according to position; it is mounted in chambers separated from the signal cabin operating chamber, and controlled by levers of the signal cabin type. A view of a cabin sectioning board is shown in fig. 14, whilst the operating levers are shown in fig. 15 (p. 782).

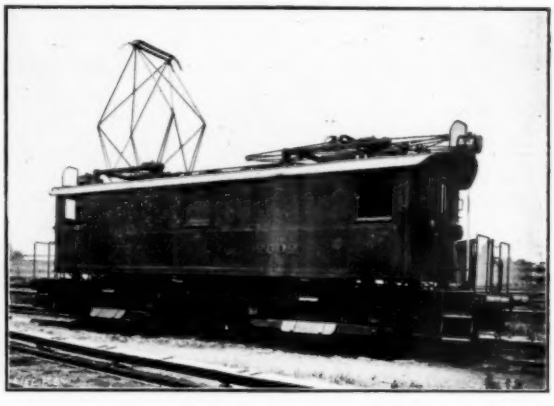

Fig. 19.—An Electric Locomotive.

Overhead Track Equipment.—The tracks in the Port section are equipped with an overhead system, current being supplied to the electric locomotives through overhead contact wires and a pantograph. The whole equipment was carried out under the supervision of the Railway Co.'s engineers. Fig. 11 shows the general type of catenary construction adopted. The overhead contact wire consists of a single 0.166 sq. in. section hard-drawn copper conductor supported by a stranded copper catenary wire 0.20 sq. in. section by means of copper wire droppers, special double insulation being used throughout.

Fig. 20.—Transporter Bridge.

The normal span between the steel structures is 80 yd., depending on the conditions existing. The normal height of the contact wire from rail level is 19 ft. 8 in.

Rolling Stock.—The equipment of the passenger stock is arranged for multiple-unit working; the coaches provided for are as follows:—25 first-class and 21 second-class motor coaches; 25 first-class and 20 second-class trailer coaches; 1 composite motor coach; fig. 12 shows a 6-coach train. The composite motor coach is used only on the spur line between Villa Luro and Versailles, 2.8 kilometres in length, where the service is infrequent. The coaches are all of the saloon type, with cross seats;

the interior of a first-class coach is shown in fig. 18. All coaches are provided with two sets of double sliding doors on each side, situated approximately one quarter of the coach length from each end.

The end arrangement of the bodies and underframes is such as to facilitate the adoption of automatic central couplers, if such a course should be deemed desirable in the future.

The motor bogie frames (fig. 16) are of pressed steel. The wheels are 3 ft. 6 in. in diameter, pressed on to a 7¾-in. diameter seat; the solid gear wheels are pressed on the axle. The coaches are fitted with vacuum brakes.

The rolling stock bodies were supplied by the Birmingham Carriage and Wagon Co., Ltd., the under frames and bogies by the Leeds Forge Co., Ltd., and the electrical equipment by the Metropolitan-Vickers Electrical Co., Ltd. The motor coaches have two motor bogies, each fitted with two motors, the nominal one-hour rating of which is 220 h.p. each—with a four-coach train containing two motors and two trailers an average acceleration on level tangent of from 1.25 m.p.h.p.s. up to 22 m.p.h. is obtained with an average accelerating current of 290 amperes per motor. With a six-coach train, consisting of two motor coaches and four trailers, an average acceleration on level tangent of 0.8 m.p.h.p.s. is obtained with a current per motor of about 270 amperes.

The voltage across the motors is 800; they have solid box frames (fig. 17), four poles, and commutating coils. The two brush holders each contain three brushes, 1¾ in. by ⅝ in.

The motors have parallel flow ventilation, a double fan on the pinion end of the armature drawing air from the commutator end in two streams, one through the armature and the other through the field. The motors of each bogie are permanently connected in parallel, the two pairs on a coach being connected in series or parallel as required.

The acceleration is automatic. At the entrance to Plaza Once station there is a section of 1 in 26 grade. A six-coach train with two motor coaches will accelerate on this grade at a reasonable rate with the relays at their normal setting. To provide for the possibility of a still lower ratio of motors to trailers, however—a condition only possible in the event of faulty equipment—means are provided on each motor coach for readily coarsening the relay setting by an additional control coil on the relay which, when energised, lifts a plunger and increases the reluctance of the main coil magnetic circuit and so allows the relay to operate more quickly—purely an emergency device, and the push button energising the coil is placed on the opposite side of the cab to the master controller so that the motorman himself cannot operate it if he is operating the controller. He must call the guard of the train to close the push button if he wishes to accelerate the action of the relay.

Electric Locomotives.—For handling freight trains to and from the Port through the tunnel from Once, two electric locomotives are provided (fig. 19) of the 0-4-4-0 type, consisting of two articulated 4-wheel bogies carrying the cab on four spring-loaded sliding seats per bogie; the four motors are of the box-frame type, with commutating poles; a blower supplies air to the motors. The equipments are controlled by contactors operated by compressed air through electrically-controlled valves.

The locomotives are fitted with straight air brakes with an emergency pipe.

There are two pantographs on the roof of each locomotive, controlled by electrically-operated air valves.

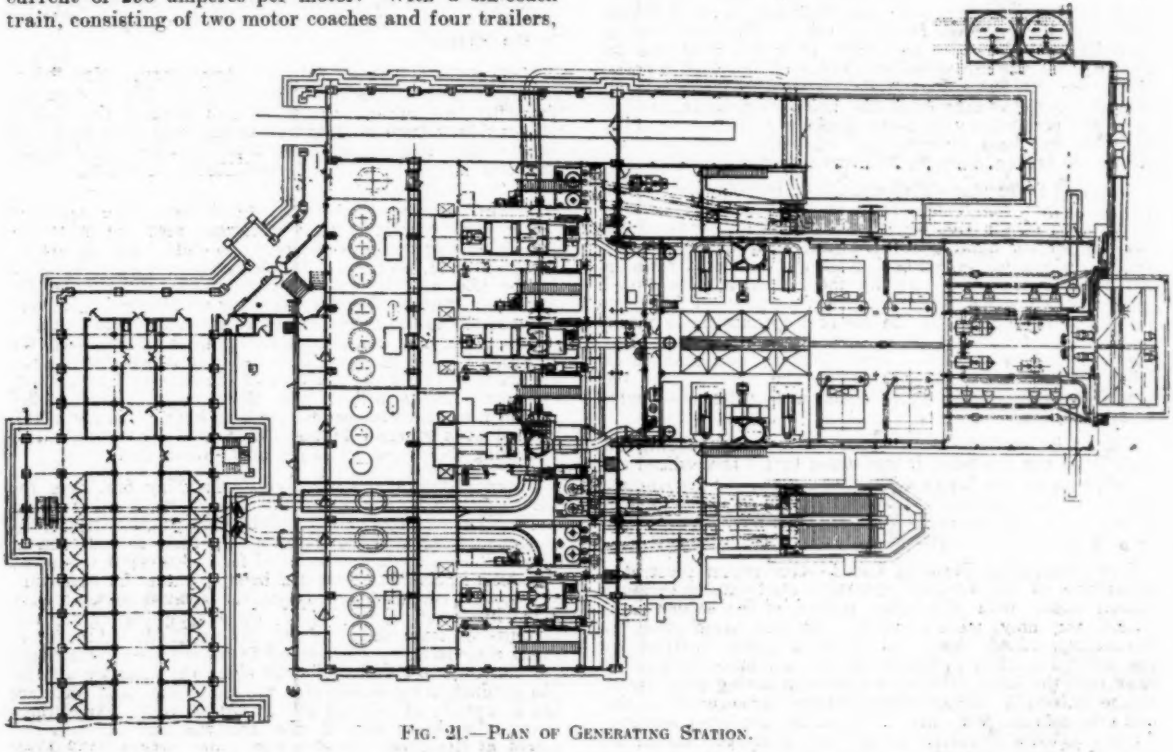

Fig. 21.—Plan of Generating Station.

The weight of the complete locomotive is 62½ tons; weight of electrical equipment, 22.3 tons; one-hour rating of motors (75 deg. C. rise), 230 h.p.; tractive effort on first step of controller, 10,000 lb.

Car Sheds.—For the reception of the electric rolling stock, a new car shed has been built at Liniers and a smaller one at Caballito sidings. Power for moving the coaches is supplied from overhead trolley wires carrying small carriages, from which hang cables that can be plugged into the train-line sockets on the coaches.

In order to facilitate the training of motormen, a complete electrical equipment of a coach has been erected in a special schoolroom at Villa Luro.

Fig. 20 shows the transporter bridge referred to in the first portion of the article, while fig. 21 is a plan of the generating station.

In conclusion, it remains to be recorded that, although some of the coaches were built in the Argentine, the bulk of them were built in England, and it is very gratifying to learn that the whole of the apparatus used in connection with the electrification was manufactured in Great Britain, the principal contracts covering the erection of the plant by the various contractors.

NOTES.

(*Continued from page* 818).

The Electric Charge of Colloids.—A lecture on this subject was given on May 16th by Professor H. R. Kruyt, of the University of Utrecht, in the Medical Chemistry Department of the University of Edinburgh. After paying a tribute to the fundamental researches of the British school of colloid chemists, from Graham, its founder, to present times, Professor Kruyt took as his central idea the proposition that the electric charge was the most universal and, therefore, the most important property of colloids, whether suspensoid or emulsoid. Professor Kruyt gave an interesting account of his own work on the stream-potential between two electrodes when water was forced through a capillary tube connecting the two electrode vessels; with pure water 25 volts could be obtained at moderate pressures; addition of very small traces of salts affected the potential, and might even reverse the charge. He showed how the origin and nature of the double layer could be deduced from the orientation in crystal structure; and in conclusion protested against the view of physiologists that proteins, and emulsoids generally, formed true solutions which obeyed the solution laws.

Electrolytic Disinfecting Fluid.—The report of the Medical Officer of Health (Dr. F. W. Alexander) to the Borough of Poplar, for 1922, states that 56,520 gallons of electrolytic disinfectant were manufactured, making 113,040 gallons as broken down for distribution. The total cost of materials and electricity was £286, of which £120 was for electrical energy. Since the installation of the plant, a period of 17 years, 684,609 gallons of fluid have been manufactured, at a cost for electricity of £1,024, and materials £1,324; less than 1d. per gallon; since the beginning of August, 1914, the fluid has been manufactured of greater strength, being afterwards broken down to half strength for distribution.

Lighting to Displace Wallpaper.—An ingenious substitute for wall-paper has been devised in the Nela Park research laboratories of the General Electric Co. It is produced entirely by electric lighting and is capable of throwing as many as fifty distinct wall-paper designs on the walls of a room in less than 60 seconds simply by the movement of a tinted glass slide, on which are arranged various coloured daubings. The effect is obtained by the use of a specially-made magic lantern box, which can be concealed and arranged so that the wall designs may be focused perfectly and changed at will. The colours and designs can be varied from the brightest to the most quiet tints and patterns.—*Reuter* (Cleveland, Ohio)

Smoke Prevention.—In the note under this heading on page 778 of our last issue, it was stated that "proceedings are to be taken by the Eccles authorities against the Manchester Electricity Committee." Obviously, this reference should have been to the Eccles Electricity Committee, and not the Manchester Electricity Committee.

The Condensing Plant at Leeds.—Our recent illustrated description of the Leeds Corporation electricity generating station dealt with the older portion of the station in a general way only, more particular attention being given to the recently added plant and to that being installed at present. Probably, therefore, it was not made sufficiently clear that the large Mirrlees surface condensing plant fitted to the 12,000-kW Escher Wyss-Siemens turbo-generator has much in common with the C., M. & M. condenser supplied for the 12,000-kW B.T.H. set that we described. So far as size, weight, amount of water circulated, length of tubes, &c., are concerned, the two sets are the same, and they have the same area of cooling surface, the only difference being the fact that the M.W. condenser is provided with a Mirrlees-Leblanc rotary air pump, whereas the C., M. & M. set has a steam jet air ejector. Besides the large set mentioned the Mirrlees Watson Co., Ltd., has supplied condensers for two 6,000-kW and two 3,000-kW generators at Leeds. The plant is said to be unique and its special arrangement was designed in 1906 by the company to meet the peculiar and difficult conditions of the cooling water supply which is obtained from the river Aire. The water contains a large amount of trade refuse, consisting of oily and woolly material discharged from the mills higher up the river, and at certain times of the year large quantities of dead leaves are also carried down. The amount of foreign matter in the water is so great that it was previously found necessary to open and clean the whole of the condensers weekly, thus entailing a heavy continuous expenditure. The working result of the special plant has been highly successful, and the effectiveness of the arrangement was proved shortly after the first condenser was installed.

During a heavy flood the whole of the earlier-installed condensers were put out of service by the choking of the tubes, whereas the new condenser only dropped its vacuum a few inches, the flow of the water through the condenser was reversed, and in the course of half-an-hour the vacuum had regained its normal value. The plant consists of vertical open-top type surface condensers, with (in the earlier type) a set of three-throw Mirrlees-Edwards air pumps, and a centrifugal water pump. The water passes only once through the full length of tubes, and for this reason the condensing efficiency per square foot of surface is lower than usual, and the cooling surface has had to be increased beyond the usual allowance. In the ordinary course of working the cooling water is delivered into a water chamber, which consists of a deep circular tank bolted to the top of the condenser; the tank is open to the atmosphere except for a light portable hinged cover. The water thence flows down through the tubes, and passes out of the bottom chamber into the main discharge pipe. For washing-out purposes the direction of flow can be reversed, the water entering the bottom chamber and overflowing from the top chamber into the discharge main. The openings into the tubes are trumpet shaped, well rounded, so that there are no projecting or sharp edges to catch the woolly material, &c., floating in the cooling water; for the same reason special care was taken to obtain smooth curves in the water heads and pipe connections. By raising the portable top cover the tubes can be cleaned whilst the plant is in operation.

Oil from Coal.—According to the *Birmingham Evening Dispatch*, Dr. P. Dvorkovitz, a Russian resident in Bradford, has devised a means of distilling oil from coal "on such a scale that England will be an exporter and not an importer." It is stated that Dr. Dvorkovitz, who is a chemical adviser to the Soviet Government, has recently had an opportunity of demonstrating the efficacy of his system at Moscow. The journal adds that the scheme is being favourably considered in the Midlands.

Visit of the Prince of Wales to Birmingham.—The Prince of Wales is to visit Birmingham on June 11th, and on the following day will lay the foundation stone of the Hall of Memory (in honour of Birmingham men who gave their lives in the war), inaugurate the new power station at Nechells, and visit the works of the General Electric Co., Ltd.

Tempering Saw-teeth with Electricity.—The teeth of power saws constantly need attention, resulting in serious delays, during which machinery is idle. By a system invented by M. Geerlops, a Dutch engineer, a great reduction in the idle time is made; he applies an electrode to the saw tooth, passing through the latter an alternating current of from 175 to 600 A, according to the size of the tooth, at a pressure of five volts, until the tooth is bright red; the electrode is then removed, and the heat is withdrawn from the tooth so rapidly by the body of the saw, that satisfactory tempering results without any other operation. A skilled workman can thus temper 400 teeth an hour. The use of this method at a sawmill in the Dutch Indies has resulted in increasing the output by 20 per cent.—*Génie Civil.*

Transmission at 220,000 Volts.—On May 6th, says the *Electrical World*, the Big Creek lines of the Southern California Edison Company were synchronised with the rest of the system and the switches were closed; thus transmission at 220,000 V became an accomplished fact. Everything went off without a hitch. The lines had been operating for some time at 150,000 volts, and before the higher pressure was used additional insulators were provided, there being now a total of 11 units on suspension and 13 on dead-ends. Aluminium shield rings having a diameter of 28 in. are used to distribute the electrostatic stress uniformly along the insulator strings. The conductors are 605,000-circ. mil aluminium, and each line has a capacity of 125,000 kW at 220,000 volts. Auto-transformers forming a part of the line are used at each end except at Big Creek No. 8 power house, where 220,000-volt transformers were provided at the time the plant was built.

High-pressure Steam.—The new power station of the Edison Electric Illuminating Co., of Boston, which is to be built at Weymouth, about eight miles from the company's L Street station, will embody several new features in design—a 1,200-lb.-pressure boiler, a 2,000-kW, 1,200-lb. pressure turbo-generator, the reheating of exhaust steam from the high-pressure set, and the use of house generators on the shafts of the main sets. A contract for two main sets has been placed with the General Electric Co., U.S.A. Each turbine has a steam-end rating of 32,000 kW, at 350 lb. pressure, and has a direct connection to a generator rated at 30,000 kW, and a house generator rated at 2,000 kW. Negotiations are under way with the same company for a 2,000-kW, 1,200-lb. high-pressure turbine which will exhaust through a resuperheater into the main steam system at 375 lb. The way is left open for an ultimate installation of three of the high-pressure sets, and the total exhaust of the three sets will supply one main 32,000-kW set at 350 lb.

The four boilers are to be furnished by the Babcock and Wilcox Co., and will operate with a total steam temperature of 700 deg. F. High-pressure economisers will be used with both the three 375-lb. boilers and the 1,200-lb. boiler.

The adoption of 1,200 lb. pressure for the initial stage requires the working out of many new problems in the design of the station. The work is under the supervision of Mr. I. E. Moultrop, of the Edison Electric Illuminating Co., of Boston, and Messrs. Stone & Webster, Inc., have been engaged to design and build the plant.—*Electrical World.*

Appointments Vacant.—Lady demonstrator for electric cooking; engineer-in-charge of machinery, &c., at the County Hall (£250+bonus=£377), for the L.C.C.; power station superintendent (£390), for the Dover Corporation Electricity Department. (See our advertisement pages to-day.)

The "Underwriters' Knot."—As an example of American practice, the following note from *Electrical Merchandise* may be of interest: "The majority of short circuits occurring in pendant sockets and the attachment-plug caps of portable electrical appliances, according to the Underwriters' Laboratories, are due to loose strands of the flexible cord, which become separated from the terminals when the binding screws or terminals are loosened.

"This loosening is frequently the result of the omission of a knot or its equivalent in the cord inside the cap of the socket or attachment plug, the strains due to pulling separable connections apart or dragging portables around by their cords being transmitted directly to the small binding-screw connections.

The "Underwriters' Knot."

"The so-called 'Underwriters' knot,' illustrated herewith, provides an easily-tied strained relief forming a rather flat knot, which will fit snugly in the recess provided for the purpose inside the cap of pendant sockets and attachment plugs."

A New Cable Steamer.—Messrs. John Brown & Co., Clydebank, have launched from their shipyard the twin-screw cable steamer *Mirror*, which they have built to the order of the Eastern Telegraph Co. The vessel will be equipped with the latest type of cable-working machinery.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* Electrical Review *posted as to their movements.

Mr. W. M. Selvey's London office telephone numbers are now: "Victoria 1796 and 1797."

Mr. David Brownlie, of 46, Grange Road, Ealing, London, W.5. (Telephone No. "Ealing 2344"), has, by amicable arrangement, severed his connection entirely with Messrs. Brownlie & Green, Ltd., of Manchester and London, and is now engaged in private practice as an advisory specialist in fuel economy.

East Ham Town Council has increased the salary of Mr. W. R. Elliott, chief electrical assistant, to £400, as from April, 1923, with further increases to £425 a year hence, and to £450 in the following year.

Mr. M. Farrer, engineer and manager, was recently presented by the staff and employés of the Twickenham and Teddington Electric Supply Co., with a gold watch, to celebrate the 21st year of his connection with the company.

On May 2nd, Mr. Samuel Insull gave a dinner at Chicago to Mr. Charles H. Merz, head of the firm of Merz & McLellan, of London, consulting engineers to the Commonwealth Edison Company. Some 200 guests were present. Mr. Insull, says the *Electrical World*, in introducing Mr. Merz, referred to him as having been connected with large electric power developments the world over and as an authority on the economical production and distribution of electrical energy, as well as an engineer of great distinction and high ideals. In responding, Mr. Merz spoke of the wonderful development attained by the electric power industry as shown by the fact that work was actually under way on a million-horse-power station. The reference, undoubtedly, was to the Crawford Avenue station of the Commonwealth Edison Company, for which Merz and McClellan are consulting engineers. Mr. Merz went on to sketch electric power conditions in Great Britain, Australia, and South Africa.

Mr. T. H. Matthews, A.M.I.E.E., has resigned his appointment as civilian electrical engineer under the Government of India, Military Works Service Branch, as from May 1st, 1923, after three years' service in India, to take up an engineering post with the Burmah Oil Co., on its fields in Burma.

A smoking concert was held in the mess-room at the English Electric Works, Stafford, on Thursday evening last week, when the Old Employés Association made a presentation to three employés of the company who have recently retired, Messrs. John Regis, R. Pattison, and W. Bishop, who have 27½, 15 and 13 continuous years' service to their credit respectively.

Gillingham (Kent) Town Council has appointed Mr. Harold Hall, of Tidworth, near Andover (Hants.), as chief electrical engineer to the borough. Mr. Hall has been chief assistant at Tidworth since 1915, and during 1919 he carried out the duties of chief electrical engineer for about six months during the illness of his chief. Mr. Hall was a pupil at Grimsby Corporation electricity works, and he has served at the Corporation electricity works at Falkirk, Worksop, Wakefield and Dewsbury. Two previous appointments to the post by the Gillingham Corporation, already mentioned in the Electrical Review, have been cancelled.

Obituary.—Mr. T. Wallwork.—The funeral took place at Mellor, on May 17th, of Mr. Thomas Wallwork, mains superintendent of Blackburn Corporation electricity department, who died following an accident, as reported in our last issue. Mr. P. P. Wheelwright, electrical engineer, was among the mourners, and two of the oldest workers assisted to place the coffin in the hearse. The following officials acted as bearers: Messrs. A. W. Goodwin, G. Walker, C. L. Faunthorpe, J. Wright, W. Mawby, and A. F. Gillis. Others present included Mr. H. W. Seymour, tramway department, Mr. E. M. Elborne, English Electric Co., and Mr. G. H. Officer, Electrical Contractors' Association. The wreaths included tokens from the Corporation electricity department and the British Insulated & Helsby Cables, Ltd., Mr. H. Russell Hornby (chairman of Electricity Committee), Mr. J. Stanworth (vice-chairman) and the Darwen electricity department.

Mr. E. W. Smith.—The death occurred on May 10th, at the age of 42 years, of Mr. Ernest Wilfred Smith, works superintendent at the Dover Corporation electricity works, with which he had been associated since its establishment some 27 years ago.

Mr. D. S. Barton.—The *Electric Railway Journal* records the death of Mr. Donald Strode Barton, former general manager of the Canadian Electric Light Co., Levis, and consulting engineer of the Quebec Railway, Light, Heat & Power Co. "Mr. Barton was born in India and was educated in England. He went to Canada in 1900. He settled in Montreal and practised his profession there for five years, when he accepted the appointment as general manager of the Canadian Electric Light Co., and at the same time became consulting engineer of the Quebec Railway. When the Levis company was absorbed by the Quebec Railway he remained with the company in the capacity of consulting engineer."

Mr. W. Powles.—*The Times* "Deaths" column records the death which occurred on May 19th, at 45, Devonshire Street, of Mr. Walter Powles, of Walter's Electrical Manufacturing Co., Ltd., aged 64 years.

Will.—The late Sir James Dewar, F.R.S., &c., of the Royal Institution, left £129,555 gross and £128,828 net personalty.

NEW COMPANIES REGISTERED.

Anglo-Polish Electrical Development Corporation, Ltd. (189,954).—Registered as a private company on May 14th, with a nominal capital of £5,000 in £1 shares (2,500 "A" and 2,500 "B"). In a winding-up the "A" and "B" shares rank *pari passu* for repayment of capital, but the "B" shares confer no right to participate in any surplus assets which belong exclusively to the "A" shares. The objects are:—To carry on the business of electrical, mechanical, and general engineers, contractors, manufacturers of, and dealers in electrical and other appliances, and apparatus, machinery, pneumatic and other engines, financiers, concessionaires, general merchants, &c. The subscribers (each with one "B" share) are:—W. J. Hill, 2, Bond Court, Walbrook, E.C., clerk; G. Dickson, 2, Bond Court, Walbrook, E.C., clerk. The subscribers are to appoint the first directors. No qualification required. Remuneration as fixed by the company. Solicitors: Linklaters & Paines, 2, Bond Court, Walbrook, E.C. No notice of situation of registered office was filed at the time of incorporation.

Wireless Experts, Ltd. (189,939).—Private company. Registered May 11th. Capital, £1,500 in 1,000 preference and 250 ordinary shares of £1 each and 1,000 founders' shares of 5s. each. To acquire and take over the licence granted to the D.K. Radio Manufacturing Co. by the British Broadcasting Co., permitting them to manufacture wireless sets, viz.:—Crystal sets and 1- to 5-valve sets, &c. The permanent directors are:—A. G. F. Krumm (managing director), 10, Turle Mansions, Turle Road, Tollington Park, Middlesex (managing director, Super Productions (London), Ltd.), W. Aldworth, 66, Greyhound Lane, Streatham Common, S.W. Qualification, 50 shares of any class, not being of less aggregate value than £25. Registered office: 312, Vauxhall Bridge Road, S.W.1.

Wireless and Electric Co., Ltd. (189,910).—Private company. Registered May 10th. Capital, £1,000 in £1 shares. To carry on the business of manufacturers of, and dealers in electrical, mechanical, scientific, and technical instruments, apparatus, appliances, and products of all kinds, wireless broadcasting and receiving instruments and apparatus, &c. The subscribers (each with one share) are:—L. H. Brooks, 33, Southampton Street, Strand, W.C.2, solicitor; J. F. Cooper, 31, Newman Street, W.1, accountant. The first directors are not named. Solicitors: Harrington, Edwards & Cobban, 33, Southampton Street, Strand, W.C.2.

Liverpool Electrical Engineering Co. (1923), Ltd. (189,922).—Private company. Registered May 11th. Capital, £2,000 in £1 shares. To acquire the business of electrical engineers, contractors, and agents carried on at 18 and 20, Vauxhall Road, Liverpool, as the Liverpool Electrical Engineering Co. The first directors are:—J. Clarke, 34, Castle Street, Liverpool; J. H. Clarke, 34, Castle Street, Liverpool; P. J. Clarke, 34, Castle Street, Liverpool. Qualification (except first directors), £100. Secretary: P. J. Clarke. Registered office: 20, Vauxhall Road, Liverpool.

F. C. Brown (Electricity), Ltd. (189,984).—Private company. Registered May 15th. Capital, £1,000 in £1 shares. To take over the business of an electrical engineer carried on by F. C. Brown at Coventry, and to carry on the same and the business of manufacturers and installers of wireless apparatus, &c. The subscribers are:—F. C. Brown, 54, Kensington Road, Coventry, electrical engineer, 950 shares; R. A. Davies, 576, Washwood Heath Road, Ward End, Birmingham, electrical engineer, 25 shares; J. A. Griffiths, 8, Richmond Buildings, Grove Road, King's Heath, Birmingham, engineer, 25 shares. The first directors are not named. Solicitor: E. D. Spencer, 8, Derby Lane, Coventry.

Radio Garage Co., Ltd. (189,928).—Private company. Registered May 11th. Capital, £800 in £1 shares. To carry on the business of automobile store and garage keepers, jobmasters, repairers and cleaners, and suppliers of electricity and motive power for motor-cars, lorries, tractors, cycles, cabs, carriages, vehicles, wireless telegraphy, aeroplanes, hydroplanes, and motor boats of all kinds, &c. The first directors are:—O. W. Pleasants, Lynn Road, Downham, motor engineer; T. L. Lyon, Paradise Road, Downham, food manufacturer (both permanent, subject to holding £50 shares). Manager: O. W. Pleasants. Registered office: Lynn Road, Downham, Norfolk.

Electron Co., Ltd. (189,959).—Private company. Registered May 14th. Capital, £100 in £1 shares. To carry on the business of electricians, mechanical and manufacturing engineers, manufacturers of glassware, electric discharge tubes, wireless, X-ray, and other scientific apparatus, &c. The subscribers (each with one share) are:—G. O. Mitchell, 26, Birchington Road, N.8, solicitor; H. J. I. Sydney, 43, Lavender Gardens, Clapham Common, S.W.11, clerk. The subscribers are to appoint the first directors. Qualification, one share. Secretary (*pro tem.*): G. O. Mitchell. Registered office: Broadmead House, 21, Panton Street, Haymarket, S.W.1.

Proctor Transport Service Ltd. (189,970).—Private company. Registered May 14th. Capital, £2,000 in £1 shares. To acquire the business of a garage proprietor, motor transport and service works, and general and electrical engineer now carried on by M. G. Proctor at Leatherhead Road, Great Bookham, Surrey. The permanent directors are:—M. G. Proctor (managing director), "Hillside," Great Bookham, Surrey; A. C. Curtis, 30, Highcroft Gardens, Golders Green, N.W.11. The said M. G. Proctor may appoint one other director. Registered office: Leatherhead Road, Great Bookham, Surrey.

Buss, Webb & Son, Ltd. (189,956).—Private company. Registered May 14th. Capital, £5,000 in £1 shares (4,000 preference and 1,000 ordinary). To adopt an agreement with H. Buss and L. Webb, and to carry on the business of electrical engineers, builders, and contractors, as formerly carried on by the said vendors at Ipswich, and that of manufacturers of, and dealers in wireless and other electrical appliances and apparatus, &c. The subscribers (each with one preference share) are:—H. Buss, 28, Withipoll Street, Ipswich, electrical engineer; L. Webb, 50, Gladstone Road, Ipswich, builder. The first directors are not named. Solicitors: Collison, Prichard and Barnes, 27, Bedford Row, W.C.

Douglas Hollis & Co., Ltd. (189,943).—Private company. Registered May 12th. Capital, £500 in £1 shares. To carry on the business of manufacturers of, and dealers in electrical goods, foodstuffs, merchandise, produce, preserved foods, textiles, perishable commodities, hardware, plant, machinery, apparatus and chemicals, contractors, farmers, importers, exporters, carriers, packers, and preservers of fruit, flowers, plants, and vegetables, warehousemen, agents, brokers, &c. The subscribers (each with one share) are:—R. J. F. M. C. W. Coit, 17, Palace Gate, W.8, merchant; A. J. Hollis, "Montreal," Oakington Avenue, Wembley Park, merchant. The subscribers are to appoint the first directors. Qualification, one share. Secretary: A. J. Hollis. Registered office: 142, Wool Exchange, E.C.2.

Scottish Radio Centre, Ltd. (12,688).—Private company. Registered in Edinburgh May 10th. Capital, £2,000 in £1 shares. To carry on the business of manufacturers of wireless instruments, sets, amplifiers, apparatus, and accessories, &c. The first directors are:—J. Smith, 19, Clarebank Crescent, Leith, electrician; B. W. Bruce, 21, Lauderdale Street, Edinburgh, advertising specialist; W. Turnbull, 60, Princes Street, Edinburgh, optician; F. B. Turnbull, 60, Princes Street, Edinburgh, optician. Solicitors: Messrs. W. & J. Burness, 12, Hope Street, Edinburgh.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Armature Repairing and Supply Co., Ltd.—A. O. John, of Fisher Street, Swansea, was appointed receiver on May 8th, 1923, under powers contained in debentures dated November 1st, 1921.

G. Weston & Sons, Ltd.—F. S. Wilks, of 31, Lombard Street, E.C., was appointed receiver on May 7th, 1923, under powers contained in debenture dated June 11th, 1920.

A. Verey & Co., Ltd.—Debenture dated May 7th, 1923, to secure £750, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: G. H. Verey, 19, Ailsa Road, St. Margaret's-on-Thames.

Parmiter, Hope & Sugden, Ltd.—Further charge on certain land and premises in Vernon Street, Longsight, Manchester, dated May 10th, 1923, to secure £500. Holders: Mary J. Ross, 45, Howard Street, Salford, and others.

Enterprise Manufacturing Co., Ltd.—Satisfaction in full on August 3rd, 1918, of mortgage debentures dated August 3rd, 1917, securing £500. (Notice filed May 9th, 1923.)

Brookhirst Switchgear, Ltd.—Particulars filed of £25,000 debentures authorised May 5th, 1923, charged on the company's undertaking and property, present and future, including uncalled capital, the whole amount being now issued.

Contraflo Condenser and Kinetic Air Pump Co., Ltd. (110,264).—Return dated April 26th, 1923. Capital, £80,000 in £1 shares. All shares taken up. 7s. per share called up on 27,000 shares; £9,450 paid; £53,000 considered as paid on 53,000 shares. Mortgages and charges, nil.

Wellingborough Electric Supply Co., Ltd. (65,747).—Return dated March 10th, 1923. Capital, £25,000 in £10 shares. All shares taken up; £25,000 paid. Mortgages and charges, £17,500.

Newmarket Electric Light Co., Ltd. (44,450).—Return dated April 30th, 1923. Capital, £30,000 in £10 shares; 2,656 shares taken up; £26,560 paid. Mortgages and charges, £14,200.

CITY NOTES.

Callender's Cable and Construction Co., Ltd.

The annual meeting was held on May 17th, at 2 & 4, Tudor Street, E.C. Sir J. Fortescue Flannery, Bart., who presided, said that the company had been fortunate enough to do better each year since the close of the war in 1918, and now to improve upon the results of the previous year. At the commencement of last year they had in hand substantial orders which gave them a good start, and during 1922 they had reaped a full year's benefit of the new plant and reorganisation in the works begun half-way through the previous year. The volume of orders secured during the year was fairly maintained, and, as a consequence, in spite of a fall in prices, they had been able to improve upon the trading results, as the profits for 1922 were approximately £34,000 more than in 1921. The manufacturing profit for the year, plus the interest and dividends on investments, amounted to £443,210. After deducting the general expenses, there was a balance of £251,788 to be dealt with, as shown in the report. Stocks in hand had fallen since the date of the previous balance sheet from £233,000 to £209,000, being an indication that they were not over-burdened with stocks upon a falling market. Amounts due from sundry debtors had fallen from £731,000 to £512,000, and trade investments had been written down and disposed of from £428,000 to £366,000. Bills payable were £23,000, as compared with £169,000 a year previously—all indications of the increasingly liquid position of the company's affairs and of the fact that every necessary writing down had been accomplished. The directors considered it prudent to maintain the dividend at the same rate as had been paid for several years, of 15 per cent. per annum, and to carry forward the remaining balance of £226,901, which would be employed in strengthening and developing the business of the company, in meeting the competition which was always with them, and generally in furthering their interests. Should it become necessary at some later period the directors would not hesitate to use part of this carry-forward in maintaining a good rate of dividend.

Having referred with satisfaction to the reduction in the Corporation Profits Tax by one-half, and expressed the hope that next year it would be removed altogether, the chairman proceeded to refer to the general outlook. He said that their expectations in the manufacture of e.h.p. cables had only partially been realised; the development had been much slower than they thought would be the case; the interlinking of neighbouring power systems, a process which sooner or later would become universal, had developed slowly, but there were indications that this very necesary feature in the distribution of electrical energy was likely to be largely adopted. When this was done the demand for e.h.p. cables must necessarily be great. The placing of such orders among the trade was only postponed for the moment, and such work must certainly be done in the near future. Some time ago the company made special provision for the manufacture of this class of mains, and there was every reason to believe that the company would receive its full share of the orders which would assuredly be forthcoming. The electrification of our railways was reaching practical fulfilment. The Brighton section of the Southern Railway was already erecting its standards to extend its electrical system further, and the South-Eastern section would, he hoped, follow at no distant date. The other railway companies were also actively engaged in preparations for the new system, and the consequent demand for e.h.p. cables would, they trusted, be reflected in the orders which that company would thus obtain. There was, however, a serious drawback, and that was the difficulty in obtaining orders from the Continent of Europe. The present unsettled condition of affairs in Europe was seriously reflected in the trade of this country, and nothing would tend more to improve the industrial conditions here and the welfare not only of employers but also of employés, than a final settlement of those thorny questions which were disturbing not only the political but the commercial circles on the Continent. It had been said that all things had their compensations, and they had found theirs in the development of the company's enterprises overseas. In India, in South America, and in several of our Colonies, the work which they had carried out had been substantial. They had recently opened out in the Far East, and had every reason to believe that their adventure in China would bring satisfactory business to their factories at home. The managing director had recently paid another visit to India, and he was sure that the effect of his visit and of the extensive knowledge and experi-

ence of that country which he had obtained then and in his previous journeys would be found in due course in their accounts. They were greatly indebted to the wisdom and sagacity with which the company had been managed. Sir Thomas Callender led the operations as he alone could lead them, and they were fortunate in their loyal and hardworking staff. They were happy in knowing also that the rank and file of their employés continued in excellent relations with the management.

The speaker concluded by remarking that the directors proposed to establish an advisory board of directors, consisting of the principal technical officials of the company. This would increase the status of those officials whose long and faithful services deserved such recognition, and would enable them to represent the company with even increased authority, whilst at the same time being a means of showing the appreciation of the directors and the shareholders of their faithful and valued service.

Sir T. O. Callender, J.P., in seconding the motion, said the past year had been full of strain and anxiety on account of the keen competition and the universal badness of trade in engineering circles. But few companies had been successful in maintaining their dividends, and he thought they were very fortunate in being able to present such a good report. Fortunately, they had been able to maintain their factories at full work, and for the present year they were fortunate in having quite a lot of work in hand, so he hoped they would be able to maintain that condition of things throughout the 12 months. When he was in India, he was able to build up and strengthen many of the connections which he had started when he was in that great country previously. After an absence of two years, he was pleased to see the great changes that had taken place for good. At the time of his last visit in 1921, he found the country seething with discontent. This year he found that the unsatisfactory movements which had taken place under the title of "non-co-operation" were very nearly at an end. There was a much better feeling and a desire to open up business and carry on work in which they were specially interested. As to China, they had not hurried the steps which they were taking there. They had had a man in the country for a year getting information for them, and they had now opened their own office in Shanghai. They expected great things from China, but it would not be for a few years. For the next year or two it would possibly be a question of paying out more than they received, but they were sure that in the end it would be as good a source of revenue to the company as India now was. The home business continued to increase, and from all sides they found those who were in the habit of using cables coming into the market in greater and greater numbers. On the whole the increase in the use of electrical energy was great and continuous. The interconnection of stations would come on. It had been slow, but it would come, as also the large power station, to which some of them had been looking forward for years past. With regard to railway electrification, that was bound to move slowly, but already, in the North of England especially, miles and miles of suburban lines had been electrified. They were looking for a very large business in the more or less near future in the development of railway electrification, beginning with local lines and finishing with the heavy traffic on the main roads.

The report was adopted.

Siemens Bros. and Co., Ltd.

Mr. G. Mure Ritchie presided on Tuesday at Winchester House, E.C., over the annual meeting of the company, and in moving the adoption of the report, he dealt with the accounts in detail. With regard to the profit and loss account, £127,309 came into the final balance sheet as against £334,112 in 1921, and the former included only £14,041 profit for 1922. Notwithstanding the poor result for 1922, they would realise that the company remained in a sound position, and that neither the considerable capital expenditure of 1922 nor the larger capital expenditure of 1923—cumulatively not less than £400,000—nor any further Excess Profits Duty payment would require or would be likely to require any further issue of shares or any addition to debenture debt. Manufacturing operations in 1922 were disappointing in their results, and the simple explanation was just this, which was axiomatic in all industrial concerns designed, developed and organised on a large scale: If they were short of orders, which must be obtained in the open market, if the factories were only partially operated, and if, at the same time, the prices available for products were such as to leave little or no margin above cost of production, then adequate profits were impossible, and that on the whole was their position in 1922. Siemens's was a composite concern, operating not in one but in a number of specialities, a position sometimes, but not always, advantageous. There were times when profits in one line much more than counterbalanced losses on others, and, perhaps, on the whole something like a good average was maintained under anything like normal trade conditions and sometimes even when in one or other lines such conditions were abormally bad; but during 1922 those plants in which most of their capital was sunk were shortest of orders, *e.g.*, the submarine cable and telephone works. Then, again, from their special nature it was not possible to utilise the plant in one factory for work in another, *e.g.*, their submarine cable plant was not convertible for the manufacturing of land cable. Every effort was made to secure at any reasonable price such orders as were being placed, and of course the high quality of all their products was unquestionable, but in the whole circumstances of the year, which included severe price-cutting in all directions, the net result was not less disappointing to the directors than to the shareholders, so that, after having paid for five consecutive years a 10 per cent. ordinary dividend free of income tax, equal to over 14 per cent., they had been unable to continue it for 1922, during which year their turnover was little more than half of that for 1921, for, although the orders received in 1922 were greater in value and still more in volume than in 1921, yet much less work was brought over from 1921 than had been the case at the end of 1920; while, moreover, many important contracts, which it was expected would have been received, were not, nor had they yet been placed, though sooner or later they doubtless would be, and the shareholders might rely on the managers continuing to make every effort to secure a large share of that work. As regarded 1922, there was little activity in submarine cable, wherein their total output was considerably below their capacity. As regarded telephone apparatus, and especially automatic exchanges, last year the various administrations responsible for this service placed few orders. Their ebonite manufacture, however, not only maintained its high standard of excellence, but the output steadily increased. Among the contracts carried out last year might be specially mentioned a submarine telephone cable connecting England and Holland, a large contract for high-pressure cable for Australia, and an automatic telephone exchange for Winnipeg, which though not yet in full operation, had evoked commendatory expressions from the Provincial Government of Manitoba. The Cunard Steamship Co. also purchased a considerable number of wireless installations; in particular they equipped the s.s. *Berengaria* with an installation which that company informed them had given them complete satisfaction. As regarded lamps, they would be aware that during recent years, as the result of research and experiment, the standard of quality had been much raised. During the war they were necessarily precluded by more important operations from developing this line as they would have liked, but later, and particularly during last year, they had devoted much attention to this manufacture, which during both 1921 and 1922 made a serious inroad on their profits. He believed that they had now extended this line of business on a sound basis, and they certainly had brought their quality up to a high standard, which compared favourably with the best on the market. Each shareholder buying Siemens lamps was helping the company, in which respect he hoped they would all use every endeavour to extend their use. Their business generally seemed to show signs of improvement, and the orders received this year substantially exceeded those for the corresponding period of 1922. They hoped that this improvement would be maintained and augmented. They would probably know that many other important industries, especially iron and steel, felt the wave of depression a year or two before it affected their own particular manufactures, and, just as a distinct revival was experienced in those other industries after the middle of last year, which with occasional halts had gone on increasing in volume and latterly accompanied by better prices, so he thought it probable that the same revival had recently reached them, that it would increase in volume, and that sooner or later prices would improve. In submarine cables they believed that various large contracts which were kept back last year could not be indefinitely delayed. As mentioned in the report, they were expanding their capacity for the production of lead-covered cable, and, although this could not be fruitful till late this year, they believed that the increased capacity would be fully utilised. As regarded telephones, it was public knowledge that the Post Office had decided to proceed rapidly with the equipment of London with automatic telephone exchanges and intended to expend many millions sterling for this purpose. As they were a company whose control, capital and works were entirely British, and as they had during recent years not only devoted much time and research to the development of this speciality but had sunk a large capital for the necessary equipment, they thought it reasonable to hope that the British Government would have due regard to these circumstances and entrust them with a good proportion of the work contemplated. In this connection it would interest them to know that a larger proportion of their capital was locked up in this particular department than in any other, though up till then the return in terms of profit had been trifling. They were in this special position, however, not by chance but by design and policy carried out year after year, because they realised the immense future for the best type of telephone and especially the importance of a first rate system of automatic exchanges. The number of telephones compared with the population of the country was much less in Great Britain than in many other lands, notably, the United States, Canada, Sweden and Switzerland, where it varied from twice to seven times the number here. There was, therefore, plenty of room for expansion, and the demand must undoubtedly increase as the population became familiar with the advantages both in business and in social life which the telephone afforded. During the whole time he had been connected with Siemens's, at any rate, since the Armistice, their policy had continuously not only been to obtain the largest volume of orders which the works could

produce from time to time, and at the best possible prices, but along with this there had been constant endeavour to realise the probable line of demand in the future, and as far as possible by anticipation to put themselves in the position of meeting that demand. In conclusion, the chairman said that they had followed a prudent policy in meeting the demands for broadcasting and had placed on the market sets which had been entirely satisfactory from the start. Their system of railway signalling had been adopted by the Great Western Railway at Winchester Station, and they hoped to see it introduced at other stations. In general, the directors sought to pursue a policy of progress and enterprise.

Sir W. Bull seconded the motion.

Replying to points raised in the discussion, the Chairman said he was inclined in the light of what had occurred to agree that the 20 per cent. bonus distribution made a few years ago was not wise, but it was done in good faith and on the best advice, and shareholders would eventually reap the benefit. Siemens Bros.' Dynamo Works Co. was a separate concern, but all the shares were held by Siemens Bros. & Co.

The report was adopted.

Shropshire, Worcestershire, and Staffordshire Electric Power Co.

Mr. E. Garcke (chairman), presiding at the annual meeting on May 16th, said that the revenue account showed a marked improvement, but it had been thought better to strengthen the position of the company by increasing the reserve than to pay a dividend on the ordinary shares. The increase in load had been progressive, and it was expected that the Smethwick, Dudley, and Kidderminster stations would be fully loaded next winter. During the year an agreement to purchase the undertaking of the Redditch Urban District Council had been entered into; this awaited the approval of the Ministry of Transport. It had been arranged to take over the station as from April 1st, 1923, and the Council had the option of re-purchase at the end of 72 years. This acquisition would reduce the all-round costs of generation and distribution, and enable supplies to be afforded to fresh districts. The company had a Bill before Parliament to secure lighting powers in the whole of the remainder of its statutory area in the South-West Midlands Electricity District, where orders were not already held by other bodies. The scheme also involved the linking-up of the company's stations with those of the Birmingham Corporation and the erection of a power station at Stourport.

Richardsons, Westgarth and Co., Ltd.

Speaking at the annual meeting on May 17th, Mr. D. B. Morison (chairman and managing director) referred to the steps taken by the directors to put the company in a sound financial position, including the investment of £100,000 in War Stock for the protection of the cumulative preference shareholders. Mention was also made of the allocation of £100,000 for the development of the internal combustion engine. It was impossible to over-estimate the beneficial effect of this provision. The company had recently secured a licence to manufacture the Doxford opposed-piston engine, which had given highly satisfactory service in high-power cargo boats. Mr. Morison announced his impending retirement and expressed his gratification at the inauguration of the staff benevolent fund.

Johnson and Phillips, Ltd.

The annual meeting was held on May 17th, at Winchester House, E.C. Mr. W. Claude Johnson, who presided, first reviewed the financial results as stated in the report. From the balance sheet it would be seen that the share capital and debenture stock remained the same as in the previous year, but there was an additional item this year, *viz.*, reserve *re* debenture sinking fund, £15,226; this sum had been set aside out of the profits of the year and applied to the redemption of £15,226 of the eight per cent. first mortgage debenture stock in accordance with the terms of the debenture trust deed. The sundry creditors and reserve for contingencies at £77,514 showed a reduction of £55,000 odd, as compared with the previous year, and no less than £383,000, as compared with the same item in the accounts two years ago. On the other side of the account, the amount for sundry debtors, £138,065, also showed a decrease of some £120,000 odd, as compared with the previous year, and was £200,000 less than it was two years ago. The explanation of those figures was that, owing to the terrible slump that set in about two years ago and the consequent falling off of orders, they had converted a large amount of debit balances and stock into cash, and again in turn from cash into investments. The book value of investments now amounted to £153,993, or within a few pounds £100,000 more than at that time last year, and with the exception of about £5,500, the whole of that sum was invested in gilt-edged Government securities, which had all appreciated in value. There was also a sum of over £82,000 in cash and bills receivable, which, with the investments, made a total of £235,000 of liquid assets. It might be thought, in considering those figures, that they had too much money in the business, but he would point out that that position had been brought about largely by the depression in trade, which they all hoped would not last long, in fact there were already distinct indications of a steady improvement in trade generally, and in their case particularly. They had excellent prospects of getting some large orders on their books in the near future which they would not be able to undertake were they not in such a strong financial position. It was also very desirable to have large cash resources in these days of unexampled competition, as they never knew to what length some manufacturers might go in cutting prices to keep their works running. He hoped, and believed, that they were on the eve of a great trade revival; they could then be much gratified that they were in such a strong financial position.

Mr. John Macgregor, the managing director, in seconding the motion, said he would like to emphasise the remarks of the chairman as to the strong financial position of the company, and to further explain the necessity for keeping their assets as liquid as possible. For the last two years, there had been strong evidence of the growing demand in the Eastern and Far Eastern markets for the manufactures of this country, and only the political and financial position had kept back the huge orders which must ultimately come to this country, in which they were bound to participate. Their home demands and requirements were almost in the same position, and only awaited more settled conditions to fructify into orders; then they would require all the liquid resources at their disposal. Meanwhile, the capital was not lying idle but had been profitably invested. After all they were a manufacturing concern, and it was work they wanted to employ every pound of their capital. He was pleased to say that the outlook was rather brighter, and they were in a position to deal with any business that might come along.

The report was adopted.

Lancashire Electric Light & Power Co., Ltd.

The annual meeting was held on May 17th. The chairman (Mr. Alfred Shepherd), in moving the adoption of the report and accounts, which were reviewed in our last issue, said that there had been a satisfactory increase in the earnings of the Parliamentary company, enabling the reserves to be strengthened. This was the first full year of operation of the two 10,000-kW sets, which had been installed in 1921; the completion of these coincided with a great expansion of the company's output, and enabled the company to attain a high position in the country as regarded efficiency and economy of generation. The coal consumption per kWh generated had been reduced from 2.19 lb. in 1921, to 1.86 lb. in 1922. The sale of energy represented an increase of 50 per cent. upon that of 1921, the principal expansion being in bulk supplies, and supplies to the textile industry. The consumers had had the full benefit of the improved efficiency; the company's additional profit was entirely due to the increased output. In consequence of contracts entered into with Manchester and Rochdale, a substantial commencement had been made with the laying of 33,000-V mains between Barton and Hill Top, Walkden. The supply from Manchester would probably be available in the coming autumn. The speaker referred to the formation of the South-East Lancashire Advisory Board, and said that it was anticipated that a similar board would be established for the Mid-Lancashire area, in which the company also had powers of supply.

In conclusion he said that the continued expansion of electrical business was such as to justify the fullest confidence in the continued success of the company.

Urban Electric Supply Co., Ltd.

Mr. P. D. Tuckett presided over the annual meeting, held at Winchester House, E.C., on April 16th. He said that the accounts showed a very satisfactory growth of profits, and if at a later stage the shareholders approved the proposals which the directors were putting forward, he thought they would find the position of the company equally improved in other respects. With their gross profits increased by some £26,000 and the fixed charges slightly reduced, they had a net profit of £62,584, which, with the £5,619 brought forward, gave them an available balance of £61,953, after deducting the half-year's preference dividend paid last November. During the year, in common with other electricity supply undertakings, they had felt the benefit of the fall in costs combined with the higher prices which they so badly needed and were so long in getting, but although their coal and wages bills showed a substantial and welcome reduction, they were still respectively 48 per cent. and 131 per cent. higher than the figures ruling in 1914. To what extent they might be able to effect further reductions in costs remained to be seen. In the long run of course they had every expectation of effecting further economies by taking advantage of the facilities afforded by the extending range of bulk supplies or by the growth of load enabling them to install new and more efficient plant. Apart, however, from these more remote economies he wanted them clearly to realise that there was no longer any possibility of large general reductions in their costs such as they had recently experienced. Turning to the other side of the account, their higher rates of charge were in force throughout last year. In some instances they had recently reduced them, and in others they looked forward to doing so as soon as the conditions warranted it, so that, apart from the gradual increase of revenue which they might expect to derive from the growth of the business, and the benefit

which they would this year derive from the shorter period of summer time, there was no prospect of any such increase in the revenue as they had realised during the last two years. Nor was it necessary that there should be, provided they continued to make steady progress, for they had now reached the stage where, subject to the arrears of preference dividend, they were in a position to contemplate the payment of a small ordinary dividend. Small undertakings like theirs could not expect to compete in price with the larger undertakings with which they were too often compared, but it would be altogether deplorable if for this reason their useful activities were to be again paralysed just as they were emerging from the depressing conditions in which so many of the smaller companies stood a few years ago. He was calling attention to that aspect of the position, because there were not wanting indications of a short-sighted agitation to force them to reduce prices prematurely or in excess of what they could afford, but he felt sure that such attempts would receive little sympathy from the Electricity Commissioners, who knew that they were doing all in their power to extend the business and bring about reductions. They had recently been enabled to shut down their Weybridge station by taking a bulk supply from Twickenham, and at the instance of the Electricity Commissioners they were now arranging to take a bulk supply at Twickenham from the Metropolitan Co. These changes and others which they hoped to make would ultimately reduce their costs and be for the benefit of their consumers, but at the start the initial expense of the change-over from direct-current to alternating-current increased their costs, so that he hoped their consumers would be willing to show the same measure of patience which they had had to exercise in the past when they were so long deprived of the relief to which they were entitled and of which they were so urgently in need. With the passage of last year's Electricity Supply Act the Ministry of Transport obtained the necessary powers to sanction their maximum rates independently of the harassing restrictions imposed by the Statutory Undertakings (Temporary Increase of Charges) Act, 1918, and he was glad to say that in all their undertakings they were now working under Orders so granted and were consequently at liberty to earn and pay ordinary dividends. It was a great relief to them and to the whole industry to feel that the passage of that Act had terminated the period of legislative uncertainty from which they had suffered during the past few years, and he sincerely hoped they might now enjoy a period of freedom from legislative interference, so that they might concentrate their attention on the development of the business. Their Newton Abbot undertaking had been purchased by the Newton Abbot Urban District Council on behalf of the Torquay Corporation under powers contained in the Torquay Corporation (Electricity) Act of last year. It was bought on the basis of "a fair and reasonable price," and they were disappointed not to have received more than the £59,275 awarded them by the arbitrator, for although that represented the return of their £66,000 capital expenditure less a reasonable deduction for depreciation, it afforded them a by no means adequate compensation for the loss of the £7,000 gross profit which the undertaking yielded them last year, more particularly as under the debenture trust deed they were obliged to apply it in redeeming 4½ per cent. debenture stock. During the past year all their undertakings had done substantially better with the exception of Cornwall, and there, as he told them last year, there could be no possibility of their doing better. The recent substantial rise in the price of tin had had a most encouraging and marked effect in reviving the activities of the mining industry, on which their prosperity so largely depended, so that, although they expected that it would still be some considerable time before they obtained anything like the full benefit of the revival, the outlook was happily very different from what it had been. Over all their undertakings they connected an additional 718 kW during the year, a considerably less addition than in previous years, but trade depression militated against power connections, and consequently a much larger proportion of their connections were for lighting. Excluding Cornwall, they sold over half-a-million additional kWh, whilst Cornwall sold over three-quarters of a million less, its output for the year having fallen by 12 per cent. as compared with 1921, andby no less than 72 per cent. as compared with 1920. They had no anxieties as to the future of the business, provided they were free to conduct it on commercial principles. There was still ample scope for development, and all the tendencies were in favour of the extended use of electricity.

Mr. H. B. Grotrian seconded the motion and the report was adopted. Subsequently a series of extraordinary resolutions were agreed to providing *inter alia* for the immediate cash payment of one year's arrears of preference dividend, on the condition that the preference shareholders would forego the remaining three years' arrears in consideration of the rate of dividend being raised from 5 per cent. to 6 per cent.; for splitting the shares into £1 shares, and offering to purchase from the holders their funded dividend certificates at 10s. in the £, instead of letting them take their chance of having them redeemed over a term of years by an annual appropriation of £1,250 out of the profits remaining in any year after payment of the current year's preference dividend and any arrears thereon.

Madras Electric Tramways (1904), Ltd.

Mr. A. M. Quill (chairman) presided at the annual meeting on May 2nd. In presenting the report and accounts he said that owing to the different rupee basis of calculation and the strike which occurred during 1921, any comparison between the latter year and 1922 was valueless. During the year the undertaking had been maintained in good repair out of revenue, and the property account had been increased by £6,349 by expenditure on extensions which were opened for traffic on December 20th, 1922. The acceleration of services thus effected should assist in overcoming the competition of the motor omnibuses in the district. The company had represented to the Corporation that before the scheme of extensions, provisionally agreed upon, could be commenced, it would be necessary to have assurances of lower taxation and restriction of competition. Since the close of the financial year the balance of the ordinary share capital had been issued, *viz.*, 3,548 shares of £5 each, producing £17,740. This had been applied to the reduction of loans shown in the balance sheet.

Shanghai Electric Construction Co., Ltd.

The operating profit for the year 1922 was £96,998, as compared with £93,080 for 1921. The total profit was £113,300, plus £6,261 brought forward. Provision for Corporation Profits Tax requires £5,000; reserve for renewals, £15,000; initial grant and annual contribution to staff provident fund, £2,532. Two interim dividends, each of 6 per cent., have been paid, absorbing £48,000, and a final dividend of 8 per cent., less income tax (making 20 per cent. for the year) is recommended, requiring £32,000, and leaving to be carried forward £17,029. The loss by depreciation of subsidiary coinage in 1922 was £139,758, which is equal to nearly 35 per cent. on the share capital. This is an increase of £46,027 as compared with the preceding year, and it is satisfactory that, although the company has to that extent lost the benefit which would otherwise have accrued from its growing traffics, profits have been maintained. The volume of traffic during the current year has increased, and it is hoped that means of counteracting the currency depreciation to some extent will shortly be found. A concession from the Municipal Council for the extension of the company's system under railless traction has been drafted, and it is anticipated that negotiations with regard to it will be completed at an early date. Arrangements for the reorganisation of the undertaking and finances of the Singapore Electric Tramways, Ltd., are in progress. Negotiations with the Municipal Commissioners of Singapore have advanced sufficiently to emit of a new traction ordinance being prepared and forwarded to Singapore for promotion in the Legislature. It is intended that a new company, in which this company will have voting control, should be formed, and that funds for the re-equipment of the undertaking should be provided by an issue of debentures guaranteed by this company, which is to receive a half share of the profits.

The meeting is to be held on May 30th, in London, and an extraordinary general meeting will follow, at which it will be proposed that each of the 40,000 shares of £10 each shall be sub-divided into ten shares of £1 each.

Pernambuco Tramways and Power Co., Ltd.—The report for 1922 states that the gross receipts were £310,486 and the working expenses £230,701, leaving net receipts £79,785, plus £1,108 brought forward. Eight per cent. prior lien debenture interest absorbed £29,631; 5 per cent. debenture interest, £51,149; 8 per cent. notes interest, £16,000; amortisation fund, £1,500; leaving a debit balance to carry forward of £17,574. Brazilian exchange has again adversely affected results in sterling. During the current year the gross and net currency results continue to show improvement. The rate of exchange, however, is still adverse to improvement in sterling.

Colombo Electric Tramways and Lighting Co., Ltd.—The profit for 1922 was £54,916, out of which £16,500 has been put to reserve and renewal fund. A dividend of 15 per cent., free of tax, as in the preceding year, is recommended, leaving £18,789 to be carried forward.

British Electric Traction Co., Ltd.—A final dividend of 3 per cent. on the ordinary stock is announced, making 5 per cent. for the year, as against 4½ per cent. for the previous year.

Belgian Company.—At the recent annual meeting of the Société Internationale d'Energie Hydro-Electrique, in Brussels, it was decided to increase the capital of the company from 90,000,000 fr. to 125,000,000 fr. At the same time it was resolved to increase the number of directors to 20, and, according to a Brussels report, the Rt. Hon. Sir Hamar Greenwood, Bart., Mr. Claud P. Serocold, of the London Stock Exchange, and Mr. Edward R. Peacock, director of the Bank of England, were added to the board.

STOCKS AND SHARES.

TUESDAY EVENING.

THE Whitsun holiday laid a certain restraint upon Stock Exchange business beforehand, and to-day, Tuesday, it cannot be said that the markets have yet fully got into their stride again. A good many orders accumulated during the week-end, and the execution of this business gave the House a couple of fairly busy hours during the morning. Later, however, animation tailed off, and members were left looking at each other, asking when a real revival might be expected.

Every week produces fresh evidence of the willingness of the public to take sound stock at reasonable prices, and the latest example is the manner in which the South Wales Electrical Power 6 per cent. debenture stock offered at 98 was snapped up. Allotments were promptly dealt with, and the price opened at ¼ premium, from which it has improved to ½ premium; the prospect is that this price will be exceeded in the near future, for apparently a fair proportion of stags applied for the issue. North Metropolitan Electric 5½ per cent. debenture has strengthened to 4¼ premium, and other new issues of this character are more difficult to buy than they are to sell.

Home Railway stocks are somewhat undecided, and an improvement towards the end of last week became lost in a fairly general dulness which overspread the market later on. Undergrounds were not affected by this, and the price of Metropolitans rose to 73¾ before it lost the fraction. Districts are up 1¼ at 56. Underground £1 shares strengthened a trifle, and the other electrical railway issues are all very firm.

Amongst electricity supply shares, Charing Cross strengthened to 11¼, Westminsters to 9¼, Smithfields to 4, and South Metropolitan 7 per cent. preference to 25s. London Electric Supply ordinary can be obtained at 4 13/16, giving a yield of 6¼ per cent. on the basis of the 10 per cent. dividend recently paid, which was 6 per cent. higher than that of the previous twelve months. Metropolitan Electric ordinary in their split form are on offer at 29s. 9d., the return in this case being 5¾ per cent., taking the last paid 8¼ per cent. dividend as the basis of calculation. Edmundson's preference at 4¼ are 7s. 6d. higher. Urban preference at 4¼ are ex the dividend on account of arrears. Newcastle-on-Tyne preference rose to 16s. 3d.; Bournemouth and Poole ordinary are up to 31s. 6d. County of London new ordinary are a little easier at 13s. 6d. premium. Llanelly 6 per cent. preference have advanced to 20s.

The Electric Supply Corporation is sending out notices to its shareholders convening a meeting for Thursday in this week for the purpose of considering, and if thought fit, of passing a resolution increasing the capital of the company to the extent of an additional £200,000. The board considers this a favourable time for raising additional share capital and of paying off at once the 5 per cent. debenture stock, which must in any event be redeemed in 1929. It is proposed to issue as soon as possible £150,000 of 6 per cent. cumulative preference shares and £50,000 in ordinary shares. Details as to prices, &c., will no doubt be forthcoming at the meeting.

Mexican Light & Power common and preferred stocks have both put on another 5 points after their rises of similar amount last week, thus making 10 in a fortnight. The improvement is due to the expectation that the American Government is on the point of giving that official recognition to Mexico which has been hoped for over so long a period, and which, hitherto, has seemed so elusive. Other Mexican utilities are steady. The tramway companies' bonds show no changes. Anglo-Argentine Tramways 5 per cent. debenture stock is a little harder, and the first preference at 3 5/16 have recovered their loss of last week. British Electric Tractions are unchanged at 74¼ and 100 for ordinary and preference respectively, business being done fairly frequently on the basis of these quotations.

Babcock & Wilcox are now quoted ex rights, and the ordinary share capital being doubled, the price of the shares in the market is, of course, divided by two, making it 2¼. British Insulated at 2½ are firmer, and General Electric preference improved to 22s. 9d. India-rubber shares, on the other hand, went a trifle lower to 13s. 9d. Siemens remain at 16s. 3d., but there has been a little recovery in the preference shares at 23s. 6d., and the debenture stock remains at 84. Tuesday's meeting had no effect, that day, upon the prices.

Brush ordinary are offered at 27s. 9d., at which the return on the money is 7¼ per cent. on the basis of the last paid 10 per cent. dividend. Both the company's debenture stocks are a couple of points up at 91 and 80 respectively.

The cable group is exceedingly placid, and in the wireless list, Marconis have picked up to 2¼. Canadian Marconis are 9s. 3d. Rubber shares show a modest rally in consequence of the raw material bracing up to 1s. 2½d. per lb. Iron and steel shares, with armament and coal descriptions, maintain a firm front, without attracting much business to them.

SHARE LIST OF ELECTRICAL COMPANIES.

HOME ELECTRICITY COMPANIES.

	Nom.	Dividend. 1921.	Dividend. 1922.	Price May 22. 1923.	Rise or fall.	Yield p.c.
	£					
Brompton Ordinary	1	12	12	36/6	—	£6 11 4
Charing Cross Ordinary	5	9	14	11¼	+ ¼	6 4 5
do. do. do. 4½ Pref.	5	4½	4½	4¼	—	5 6 0
Chelsea	1	6	10	1⅞	—	5 14 3
City of London	1	14	15	2¼	—	6 8 2
do. do. 6 % Pref.	1	6	6	23/-	—	5 4 4
County of London	1	8	10	38/9	—	5 8 3
do. do. 6 % Pref.	1	6	6	23/-	—	5 4 4
Edmundson's Ordinary	3	Nil	—	2½	—	Nil
do. 6 % Pref.	5	12/-	—	4¼	+ ¾	6 8 0
Kensington Ordinary	5	10	12	8⅝	—	6 18 4
London Electric	3	4	10	4⅝	—	6 5 6
do. do. 6 % Pref.	5	6	6	5¼	—	5 17 1
Metropolitan	1	7	8½	29/-	—	5 17 4
do. 4½ % Pref.	1	4½	4½	18/-	+1/-	5 0 0
Newcastle-on-Tyne Ordinary	1	Nil	2½	7/8	—	2 17 2
do. 5 % Pref.	1	5	5	16/3	+6d.	6 3 1
do. 7 % Pref.	1	7	7	24/6	—	5 14 3
Notting Hill, 6 per cent. Pref.	10	6	6	9½	—	6 9 9
North Met. Elec., 6 % Pref.	1	6	6	1⅛	—	5 13 0
Urban Ordinary	3	Nil	—	1⅝	—	Nil
do. 5 % Pref.	5	2½	—	4½xd	+ ⅛	5 11 1
St. James' and Pall Mall	5	12	14½	11	—	6 11 10
South London	1	7	10	12	—	5 14 3
South Metropolitan Pref.	1	7	7	1¼	+ ¼	5 12 0
Westminster Ordinary	5	10	12	9¼	+ ⅛	6 3 1
Whitehall Elec. Invst., 7½ % Pf.	1	7½	7½	19/6	—	7 13 10

HOME RAILS.

Central London Ord. Assented	Stock	4	4	73	—	5 9 7
Metropolitan	,,	2½	8½	73	+1½	4 16 0
do. District	,,	1	3	56	+1½	5 7 2
Underground Electric Ordinary	10	Nil	Nil	9½	+ ¾	Nil
do. do. "A"	1	Nil	Nil	8/6	—	Nil
do. do. Income	Stock	4	5	97	— ½	*5 3 1

TELEGRAPHS AND TELEPHONES.

		Dividend. 1920.	Dividend. 1921.			
Anglo-Am. Tel. Pref.	Stock	6	6	104½	—	5 14 10
do. Def.	,,	1½	34/6	22¾	—	6 11 2
Chile Telephone	5	6	6	6¼	—	4 16 0
Cuba Sub. Ord.	10	7	7	7½	—	9 6 8
Eastern Extension	10	10	10	18⅞	—	5 6 8
Eastern Tel. Ord.	Stock	10	10	187½	—	5 6 8
Globe Tel. and T. Ord.	10	10	10	19	—	5 5 3
do. do. Pref.	10	6	6	11⅜	—	5 3 0
Great Northern Tel.	10	24	22	80	— ½	7 5 6
Indo-European	25	10	10	32½	—	5 7 8
Marconi	1	25	15	2¾	+ ⅛	6 6 1
Oriental Telephone Ord.	1	12	12	25	—	*4 8 6
United R. Plate Tel.	5	8	8	7½	—	*5 10 4
West India and Panama	10	Nil	Nil	5/-	—	Nil
Western Telegraph	10	10	10	18½	—	*5 6 8

HOME AND FOREIGN TRAMS, &c.

Anglo-Arg. Trams. First Pref.	5	5½	19½	3⅞	— ⅛	8 6 0
do. do. 2nd Pref.	5	Nil	5½	2⅛	—	9 7 2
do. do. 5 % Deb.	Stock	5	5	82½	+1	6 1 3
British Electric Traction Ord.	,,	4½	—	74½	—	6 0 10
do. do. 6 % Pref.	,,	6	6	100	—	6 0 0
Brazil Tractions	100	Nil	Nil	51	—	7 16 10
Brit. Columbia Elec. Rly. Pcs.	Stock	5	5	67½	—	5 15 7
do. do. Preferred	,,	5	93/-	79½	—	*6 0 0
do. do. Deferred		3	124/-	88½	—	*6 19 9
do. do. Deb.	,,	4½	4½	81	—	5 5 0
Lond. & Sub. Trac. 5 % Pref.	1	2½	3½	11/-	—	9 2 0
London United Tram. Deb.	Stock	4	4	65½	—	6 2 2
Mexico Tram. 5 % Bonds	—	Nil	Nil	34½	—	5 18 4
do. 6 % Bonds	—	Nil	Nil	63½	—	Nil
Mexican Light Common	100	Nil	Nil	31½	+5	Nil
do. Pref.	100	Nil	Nil	61½	+5	Nil
do. 1st Bonds	—	Nil	5	70½	—	6 10 9

MANUFACTURING COMPANIES

Babcock & Wilcox	1	15	20	2¼	—	4 14 1
British Aluminium Ord.	1	10	5	20/9	—	4 16 5
British Insulated Ord.	1	15	15	2½	+ ⅛	6 0 0
Callenders	1	15	15	2⅞	—	6 8 0
do. 6½ Pref.	1	6½	6½	23/-	—	5 13 1
Crompton Ord.	1	10	5	2	—	6 13 4
Edison-Swan	1	10	Nil	4/8	—	Nil
do. do. 5 % Deb.	Stock	5	5	64	—	7 16 4
Electric Construction	1	10	10	28/9	—	6 19 2
English Electric	1	8	5	17/6	+9d.	5 14 3
do. do. Pref.	1	6	6	20/6	—	5 17 1
Gen. Elec. Pref.	1	6½	6½	23/9	+6d.	5 9 5
do. Ord.	1	10	5	19/6	—	2 7
Henley	1	15	15	2⅞	—	6 3 0
do. 4½ Pref.	5	4½	4½	4½	—	5 0 0
India-Rubber	1	10	—	1½	—9d.	—
Met.-Vickers Pref.	2	8	8	8½	—	6 0
Siemens Ord.	1	10	10	16/3	—	Nil
Telegraph Con.	12	20	20	25½	—	*4 16 0

* Dividends paid free of Income Tax.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A Novel Contactor Relay.

In the contactor type motor-control gear, made by Messrs. W. H. Allen, Sons & Co., Ltd., Queen's Engineering Works, Bedford, the use of dashpots for obtaining a "time-lag" between the operation of successive contactors has been abandoned.

In its place, the firm has introduced a mercury relay which is certainly simpler than a dash-pot and less likely to give trouble.

As will be seen from fig. 1, this relay (A), which is rectangular in shape, is mounted upon the right-hand side of the contactor-switch, being swung through an angle of 90 deg. by the action of a small bar, mounted upon the contactor arm, against a pin fixed to an extension of the relay spindle.

Fig. 2 illustrates the action of the relay. The left-hand illustration shows the device at rest—inactive. The mercury, when the relay is swung over, falls into the channel and gradually trickles through an adjustable valve into the part

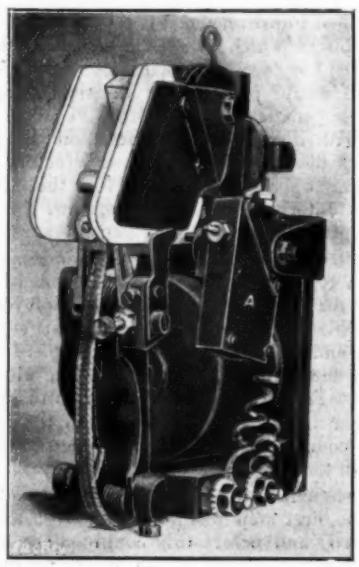

Fig. 1.—Contactor Fitted With Mercury Relay.

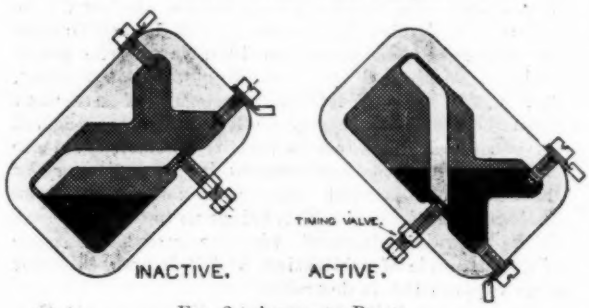

Fig. 2.—Action of Relay.

of the chamber containing two contacts, eventually closing them. The leads from these contacts are connected to the operating coil of the next contactor which is, of course, arranged in the same way.

The contactor itself possesses all the usual features. The contacts of the main circuit meet in a rolling motion and by reason of their special shape sparking takes place only at their horns, thus affording protection to those parts where the main contact is made. A powerful magnetic blow-out embraces the tips for the purpose of immediately quenching the spark. The cheeks of the coils are so hinged as to facilitate inspection and replacement when necessary.

The design is registered under Patents Nos. 4,959/22 and 1,762/23.

Lifeboat Illumination.

Among the recommendations contained in the report of the Merchant Shipping Advisory Committee is one dealing with the illumination of lifeboats upon launching. Apart from the aid thus afforded in transferring people from a sinking ship to the boats, the illumination has a certain psychological effect which cannot be ignored. A device for lighting a lifeboat upon launching has been developed by Messrs. T. Blair and Co., ship repairers, &c., King Street, West India Dock Road, E.14. Upon the gunwhale of each boat are pivoted two battens, upon the ends of which are fixed two 4-V electric lamps. These are supplied with current from a small accumulator battery which is capable of maintaining the illumination for 24 hours. A float attachment is fitted to the stern of the boat, so that immediately the craft reaches the water, the lights are switched on. Auxiliary switches are also provided so that the lamps may be extinguished if they are not required. The arms bearing the lamps may be tucked away under the gunwhale or raised to illuminate a larger area. The designers of the system are anxious to make arrangements for its sale or manufacture under licence.

A New Corrosion-proof Switch.

To complete its range of corrosion-proof fittings, the St. Helens Cable & Rubber Co., Ltd., Warrington, has designed a new switch, which is illustrated in section in fig. 3.

The general principle is the same as in the firm's other corrosion-proof fittings, *i.e.*, the cable ends are brought into an inner chamber and sealed by means of a semi-fluid compound of a waterproof and insulating nature. An ordinary rotary switch is employed and the revolving contacts are operated by a knob on the cover, the sides of which dip into the compound and so prevent corrosion attacking the metal parts. The body of the switch is substantially made in tough ebonite, and is provided with extension pieces for fixing to walls, &c. The revolving cover, which is also made in strong ebonite, is screwed on to the rotating contacts by means of the existing screw which ordinarily holds the knob. The switch is easily

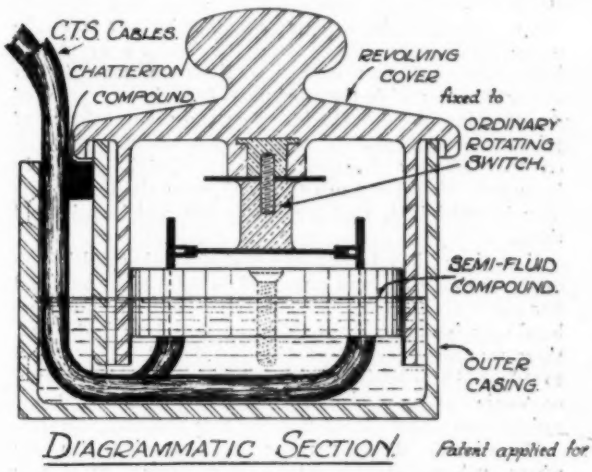

Fig. 3.—A Corrosion-Proof Switch.

and quickly wired, as the contacts and porcelain base can be removed as a whole, being fixed to the body by means of two screws. The switch can be supplied for 5, 10 or 15 amperes. Although the semi-fluid compound is sufficiently waterproof to prevent moisture or corrosion entering the inner chamber, it is recommended, as an additional safeguard and to prevent water collecting on top of the compound, that a small amount of soft Chatterton compound be pressed into the opening through which the cables are taken.

A provisional patent has been taken out for this new design.

A New Electromagnetic Compass.

A development of the new "earth induction compass" similar to that designed for airships but intended for vessels at sea has been practically completed by Dr. L. J. Briggs and Dr. Paul R. Heyl, of the U.S. Bureau of Standards.

Two direct currents are generated by revolving two pairs of brushes at a speed of about 1,400 revolutions per minute in the magnetic field of the earth. The instrument is so adjusted that when set for a compass bearing the currents flowing from each pair of brushes are equal and produce no effect on a galvanometer. If the instrument turns even slightly, one current becomes stronger than the other and the dial needle is deflected.

The advantage of the instruments for war vessels is that while the generator may be put in a fighting top at the greatest possible distance from any effect of the magnetism of the metal of the ship, the control dial may be on the navigating bridge. In contrast to the gyroscopic compass, now in use on many vessels of the navy, the new compass is inexpensive, and within the reach even of the smaller merchant craft.—*Science Service.*

ARBITRATION IN THE ELECTRICITY SUPPLY INDUSTRY.*

By J. W. THOMAS, B.Sc., A.M.I.E.E.

Now that the smoke of battle has cleared away, it is possible to consider more dispassionately the crisis through which the electricity supply industry has recently passed, and to attempt to understand the issues which were involved and evaluate the results of the settlement.

What must have struck an impartial observer was the gradual shifting of the issues as the crisis developed and the relegation of some of the original questions in dispute to the background. The primary cause of the trouble was, of course, the working agreements which had been arrived at between the E.P.E.A. and certain trade unions of manual workers.

Any attempt to enter into a detailed discussion or justification of these agreements would lead us into controversial by-paths which we are anxious to avoid, and, seeing that a satisfactory understanding with regard to them has been reached, it is undesirable that we should re-open the subject. It may, however, be stated that the members of the E.P.E.A., on learning the employers' objections, endeavoured to place themselves in their position, and to appreciate their point of view without necessarily agreeing with it. Conversely, we believe, many employers, though differing perhaps as to methods, were not altogether unsympathetic to the objects which the E.P.E.A. had before it when it entered into these agreements. It may be openly stated that the Association had no aggressive intentions, but was merely anxious to come to an understanding with the workmen for the purpose of maintaining peace in the industry and the upholding of joint agreements arrived at by employers and employed on the Whitley Councils in the electricity supply industry. However much the wording of the agreements may be criticised, that was the spirit which animated them.

Experience has taught the E.P.E.A. that, although many authorities were prepared to adhere to national agreements, there were some which were not, and as no legal coercive measures could be employed against them, there was no other alternative but for the Association to adopt the ordinary trade-union method of applying economic pressure. Joint action with other trade unions was a method of making this pressure effective.

The dispute at Halifax was an illustration of a case where such agreements might be necessary, as it was also an instance of an authority refusing to adhere to the agreed decisions of the Board. Further than this, however, it was typical of the dangers which were likely to arise consequent upon the Board's suspending operations. Without being dogmatic on the point, we should be safe in asserting that had the rupture not occurred, the Halifax dispute would probably not have arisen, and certainly not in the way it did. The main contention put forward by the Corporation before taking action against the staff was that, together with other Corporations, it had been pressing for a revision of the schedule, and that the suspension of the National Joint Board's activities and the interruption of the negotiations had increased the delay and left it with no option but to take matters into its own hands. In the opinion of the writer, the decision of the Corporation was not merely erroneous, but was highly unwise, as it both served to complicate the issues and to confirm the suspicions of the staffs that there were many electricity authorities that were only too glad to seize the opportunity of making the breakdown of the Board the excuse for cutting down salaries. And it is not open to doubt that had a stand not been made by the Association, Halifax would have been followed by other authorities which were anxious to sever their allegiance to the Boards, and to make arbitrary adjustments to the national schedule.

The Halifax dispute may then be regarded as the critical turning-point in the controversy with the employers on the working agreements, as it had the effect of deflecting the main discussion and focusing it upon a new but closely-related issue. The Association could not but feel that the dismissal of the men at Halifax had a vital relation to the deadlock on the Board, and there were clearly two tasks to be accomplished upon which the whole strength of the Association must be brought to bear:—

(1) The reinstatement of the men who had been dismissed.

(2) Radical improvement of the Whitley machinery in the industry which would make a repetition of the Halifax dispute rare or even impossible in the future, and which would provide for decisions given by the Boards being made effective.

It was with these objects in view that the Association balloted its members, with very satisfactory results.

Following upon the request for the Ministry of Labour to intervene, a conference with the employers was arranged, and terms of settlement were agreed.

The result of the conference is now common knowledge. As regards object No. 1, the terms of settlement included an agreement that the employers on the National Board would co-operate with the staff in using their best endeavours to secure a settlement of the dispute, and the reinstatement of the men who had been dismissed. Failing this, they would do their utmost to arrange for them to be absorbed into the industry in positions commensurate both as regards status and salary with those which they held at Halifax.

It was obvious that as far as object No. 2 was concerned, the first step was to re-establish the National Joint Board, and before this could be accomplished it was necessary to arrive at an understanding on the question which had been the primary cause of the breakdown, *viz.*, the working agreements between the E.P.E.A. and other trade unions. As the negotiations on this issue had made considerable progress previously, a satisfactory understanding was soon reached, and in the writer's opinion the terms of settlement reveal how narrow the gap really was which separated the two sides. This fact in itself is conclusive evidence of the need of some improvement in the machinery of conciliation of a kind similar to that agreed upon during the conference. This brings us to the main item in the terms of settlement, *viz.*, the agreed acceptance of the principle of arbitration, and it is upon this that some explanation is desirable.

Two important questions naturally arise: (1) How far electricity authorities, particularly Corporations, can and will bind themselves to agree to arbitration as a regular practice. (2) To what extent, and under what circumstances the principle of arbitration can be applied.

As far as delegated powers to act on behalf of electricity authorities in general can be given, it is presumed that the employer representatives on the National Board were justified in agreeing to arbitration, but all who have had dealings with municipalities will be aware of the reluctance with which they part with any of their authority, and it may be found that when the test comes, some Corporations may not consent to follow the lead given by their representatives.

Another moot point will be the extent to which Municipal Councils can bind themselves or their successors to such a principle.

The suggestion has been made that if the arbitration

* We understand that the opinions expressed in this article by the Assistant General Secretary of the E.P.E.A. are his own, and not necessarily those of the Association.—Eds. Elec. Rev.

clauses are inserted in the schedule which deals with salaries and conditions and differences arising therefrom, there will be no insuperable difficulty in securing the adhesion of Corporations to the principle of arbitration. It is obviously essential that if the staffs are to be tied to adopt the principle, then employers as a whole must be prepared to do likewise, otherwise the agreement will be largely one-sided. This point requires to be clarified as soon as possible. Presumably we shall have to wait until the revised schedule, which contains the necessary provision for referring differences to arbitration, has been submitted to the undertakings throughout the country before any generalisation can be made on the point. It may be remarked, in passing, however, that as the Electricity Supply Acts prevent the trade unions in the supply industry from employing methods which they might adopt in other industries which are not public services, and keeping in mind that electricity supply is a vital industry, there should be no hesitation on the part of electricity undertakings in conceding the principle of arbitration as a *quid pro quo*.

Some discussion has also ensued on the pros. and cons. of inserting the arbitration clauses in the constitution of the Board as well as in the schedule. It is argued that the former is necessary in order to bind both parties to arbitration in case a deadlock arises on an issue which does not come within the purview of the schedule. As this point is not yet decided, it is not proposed to elaborate the arguments here.

It is with regard to the application of the principle to practice that it will be interesting to watch results. As the step is a new one, it may be looked upon in the nature of an experiment, and it is not possible to pronounce dogmatic opinions on its efficacy until a little time has elapsed. There are, of course, two main types of differences which may arise between employers and employed in the industry, to which the principle may be applied :—

(1) Differences between the two sides of the N.J.B. on a national issue, such as salaries and conditions.

(2) Differences which arise between the Association and an individual authority.

With regard to the former, one does not foresee much difficulty, as it is generally recognised that if a deadlock arises on a question of salaries, the adjudication of some external authority should be sought. It may be remarked, incidentally, that arbitration on such issues has its disadvantages as well as its advantages. Its greatest recommendation is that it is a method of settling differences by peaceful means, but its greatest drawback becomes evident when arbitration is desired on an issue on which a judicial decision cannot be given. The court of arbitration, under those circumstances, can only act on the principle of splitting differences, and usually this principle has nothing to do either with justice or the ability of the authority to pay. It is on this account that trade unions in the past have been shy of compulsory arbitration.

As regards the latter type of difference, there are three kinds of authorities with which the Boards may have to deal: (*a*) Those which are parties to the Board; (*b*) those which are not parties to the Board, but have adopted the schedule containing the arbitration clauses; (*c*) those which are neither parties to the Board nor have adopted the schedule.

Type (*a*).—A difference will be referred to the Boards, and if there is agreement the decision of the N.J.B. will be binding. Should the authority refuse to adopt the decision, it is an arguable point whether arbitration under the Industrial Courts Act could be sought. If it could, then presumably the arbitration would be held on the question whether the undertaking should apply the agreed decisions or whether there were special circumstances which entitled it to special consideration.

In the case of the N.J.B. not being able to agree, the matter would automatically go to arbitration. The point arises, then, whether the decision of the arbitrator under the Industrial Courts Act would be binding. In this connection it will be interesting to quote from the book of Sir William Mackenzie on "The Industrial Court," in which he states that—

"It is expected that once a decision has been given, it will be loyally accepted by the parties. The arbitration is voluntary; this is the keynote of Part 1 of the Industrial Courts Act, 1919. There are no penal provisions for refusing to observe the terms of an award. But in certain cases the one party may have a civil remedy against the other in the local Courts."

From this statement it would seem possible for an employé to sue an undertaking for failure to carry out an award, though it is not clear whether the undertaking might not thereupon terminate the contract of service and so free itself from its obligations incurred by the arbitration. It may be noted that in the above case it is assumed that the consent of the authority to go to arbitration is implied consequent upon its acceptance of the schedule and conditions which contain the arbitration clauses.

Type (*b*).—The procedure would be similar to that outlined above.

It may be pointed out that some authorities, such as Glasgow, may agree to adopt the salaries with conditions which are equal to or better than those laid down in the schedule, without adopting the schedule as a whole.

Type (*c*).—The Association would endeavour to secure the operation of procedure in line with the above, and would look to the employers to assist it, but it would not be able to call automatically for arbitration, as the authorities would not be consenting parties.

It will be seen that the principle in practice may have wide and far-reaching implications, and, in fact, the adoption of it may prove to be an epoch-making event in the electricity supply industry. It must be borne in mind, however, that the term "compulsory arbitration" is not an accurate description. It could be better described as arbitration by consent after the fullest conciliatory methods have been tried and failed. Given goodwill on both sides of the Board, and a disposition on the part of electricity authorities to adhere to the Whitley Council machinery, occasions when the principle would need to be applied should prove to be rare in practice.

The main object is to ensure that the authorities carry out the agreed decisions of the Boards, and the fact that their representatives have agreed to arbitration should go a long way in the direction of achieving this. It may be argued that even this is not adequate for the industry in view of the fact that there are still some authorities which will not stick to the bargains which they have made, and the only method to be employed against them is that of legal enactment. Whether this is desirable is still one of the unsettled problems in industry.

In this country there is a long and honourable tradition of industrial agreements having been faithfully observed, and there has usually been a reluctance to employ legal compulsion. As the employers said to Mr. Ramsay Macdonald when he offered to intervene in the dispute with the Federation of Engineering and Shipbuilding Unions: "If collective bargaining is to be usefully maintained in industry, constituent members must honour agreements negotiated and concluded between parent organisations."

It is very likely that where there is good faith on both sides, the absence of coercion is all to the good. When, however, a suspicion, confirmed by experience, exists that one side does not fulfil its obligations, the only remedy is to apply coercion in some form or another.

In many quarters recently, *e.g.*, the bootmaking industry, the desirability of making agreements arrived at by recognised national bodies enforceable by law has already been discussed, and during the last General Election the majority of Parliamentary candidates expressed themselves in favour of so doing. As was also pointed out by Mr. Stoker, K.C., in an article in the Electrical Review of April 6th, the possibility of a time arriving when legal sanction would be necessary

was adumbrated in the Whitley report, and it is now a question whether the time is ripe for a further step in this direction to be taken. One might also refer to the recent discussion in the House of Commons on "Professional Workers," where one member raised the same point, whether the time was not approaching "when the burdens and privileges which Whitleyism imposed on both sides ought to be given the force of law."

Whether the time is ripe in the electricity supply industry will depend largely upon the consensus of opinion that exists in favour of it. The employers' side of the Board are, apparently, favourably inclined, as also are the technical staff. One gathers, however, that the manual workers' trade unions are divided in opinion on the question, and it is for that reason that no attempt has yet been made by the Whitley Council machinery as a whole to secure legislative sanction.

The terms of settlement may be looked upon as a half-way house towards such legal enactment, as they bring the force of Governmental decisions to bear, through the Industrial Court, on recalcitrant undertakings which are parties to the Boards, but such force only becomes operative after initial consent has been given.

The weak point of the terms of settlement, and one on which they may be most criticised, is that they do not solve the problem of bringing into line those authorities which are not parties to the Boards. In the absence of legal enforcement, there is obviously only the alternative method left of the Association employing such economic pressure as it can, and to make this effective it will probably retain working agreements with the other trade unions.

In summing up, one may ask what good results, if any, have accrued from the Conference and the settlement.

The main item on the credit side is undoubtedly the re-establishment of the National Joint Board. It would have been a matter of great regret both to the general body of employers and to the staffs in the industry had no solution of the deadlock been arrived it. In spite of the adverse criticisms which have recently been passed against the institution of Whitley Councils in the various industries, and the charges which have been made, *e.g.*, by Lord Leverhulme, "that they have been responsible for unrest," few will deny that in the electricity supply industry they have been conducive to good feeling between employers and employed, and have performed useful functions by settling differences without strife.

Another great gain is the reaffirmation, as far as the staff is concerned, of the principle of arbitration. No doubt the efficacy of arbitration can only be determined by experiment, but one may hazard the guess that in practice it will prove a step of far-reaching importance and helpfulness to the industry.

Finally, one may safely assert that the crisis and the Conference had the effect of arresting a general landslide throughout the country, as there were other authorities like that of Halifax which were anxious to break away from the Boards, and to vary the salaries of their staffs to suit themselves.

The refusal on the part of the Association to agree to such arbitrary reductions, and the united stand made by the members, were influential in stemming the tide, and it is to be hoped that now that the terms of settlement have been agreed and the revised schedule completed, tranquillity will be maintained for a long time in the industry, so as to enable the technical staffs to pursue their allotted tasks undisturbed by the alarums of industrial strife.

MERSEY AND WEST LANCASHIRE ELECTRICITY DISTRICT.

Commissioners' Liverpool Inquiry.

Two years have elapsed since the Electricity Commissioners held an inquiry at Liverpool regarding the formation of a Joint Electricity Authority for the Mersey and West Lancashire Electricity District. The Commissioners have issued a draft order, and when the second inquiry opened at Liverpool on May 17th, at the very outset attention was drawn to the changed conditions, especially the additional support which had been received from authorities in the Wirral, and the withdrawal of the Liverpool Corporation from the scheme.* Counsel for the Provisional Committee, formed of authorities on the Liverpool side of the Mersey, at the opening session emphasised the support which had been received from councils in the Wirral, and sounded a controversial note when he suggested the elimination of the proposal to create a separate joint board for the Wirral peninsula, and the inclusion of the Wirral in the West Lancashire scheme.

Immediate exception was taken by Wallasey and Birkenhead to counsel's statement, and at the second session, Mr. A. W. Miller, K.C., argued at length that the Commissioners could not reverse decisions which were given effect to in the scheme now before the court, as the result of the first inquiry. This point was argued for nearly two hours when Sir Harry Haward (one of the Commissioners) pointed out that the Commissioners had full power to give what decisions they chose, and it was open to authorities when the draft order was submitted to the Ministry of Transport, to lodge an objection with the Ministry, that the Commissioners had arrived at decisions of which they had had no adequate notice at the inquiry.

The Commissioners were Sir John Snell (chairman), Sir Harry Haward, and Mr. W. W. Lackie. Mr. E. W. Hudson was present as legal adviser, and Mr. Cumberledge as clerk to the Commissioners.

Amongst the interests represented were:—The Liverpool, Bootle, Birkenhead, Southport, Warrington, and Wallasey Corporations, Mersey Power Co., Ormskirk Gas & Electric Co., Mersey Dock & Harbour Board, Manchester Ship Canal Co., L.M. & S. Railway Co., the Provisional Committee of the Mersey District, Lever Bros., British Insulated & Helsby Cable Co., L. & N.E. Railway, United Alkali Co., and the Councils of Wirral, Bebington, Bromborough, Litherland, Wilpshire, Hoylake, West Kirby, Northwich, Waterloo and Seaforth, Lymm, Newton-in-Makerfield, Great Crosby, Ormskirk, Formby, Burscough, Leyland, Ellesmere Port, Whitby and Whiston.

Mr. E. Wooll, who appeared for the Provisional Committee of the Mersey & West Lancashire District, supported the draft order issued by the Commissioners, subject to representations and objections which would be put forward. The support of the boroughs which had seceded from the scheme since its original formation, had been consolidated, and they had been able to enlist reinforcements in the bulk of the authorities in the Wirral peninsula. Six-sevenths of the Wirral area was with the provisional committee, and was in favour of supporting the draft order, subject to representations and objections with which he would deal.

Mr. Wooll then referred to the amalgamation of the Bootle electricity undertaking with Liverpool, a step which, he said, was largely due to the educative work achieved at the last inquiry. It had opened the eyes of those willing to see. The Provisional Committee quite understood the point of view of Liverpool, and he thought that both parties would succeed in marching with one another as far as either of them wanted to go. Mr. Wooll suggested that the Wirral district should be included in the West Lancs. scheme.

Mr. Jeeves, K.C., for the Wallasey Corporation, said that if it was desired to do this, the proceedings would have to be scrapped, and the work begun all over again. Birkenhead and Wallasey could not be brought into the present scheme. Both Councils objected to the expunging of the Wirral Joint Electricity Board.

Sir John Snell: Suppose that these authorities in the Wirral, other than Wallasey and Birkenhead, make good their point that they should not be included in the Wirral Joint Board—it leaves the two Corporations isolated; is it necessary to go through the whole of the machinery for the formation of a joint board?

Mr. A. W. Miller, K.C., said that the Commissioners had decided in favour of the provision of super-stations for the Wirral, and they could not go back on that finding.

Mr. Wooll reiterated that the time was ripe for the amalgamation of the Wirral undertakings with the West Lancs. scheme, and especially in view of the probable electrification

* Electrical Review, May 11th, 1923; p. 757.

of the local railways and the probable erection of a super power station at Liverpool from which the Wirral could be served. The estate of the Mersey Dock & Harbour Board was on both sides of the river, and with the railway companies and other business undertakings it disapproved of the proposal to endow authorities on both sides of the Mersey with powers so distinct in character. At the last inquiry only the Councils of Bebington, Bromborough, Hoylake, and West Kirby supported the bigger scheme; to-day the Provisional Committee had the support of all the public authorities outside Birkenhead and Wallasey.

Mr. Wooll asked the Commissioners to exclude the Lancashire Electric Power Co. from supplying electricity in the district of the Joint Authority, and to insert a clause in the draft order enabling the Joint Authority to enter into negotiations with authorities owning stations and transmission lines for the transfer on lease, or control of such stations and lines on terms equitable to all parties. Until the draft order was confirmed by Parliament the Electricity Authority remained a "ghost," with which no one would enter into agreement. They wanted the order to go through this session. Whilst the withdrawal of the Liverpool Corporation was deplored, the Provisional Committee regarded the Corporation as an ally in restoring the electrical balance of the scheme.

At the commencement of the afternoon session, Mr. C. Cole, clerk to the Council of Newton-in-Makerfield, in the area supplied by the Lancashire Electric Power Co., said that there was a local demand for electricity, but there was no public supply. Quotations had been received from the St. Helens Corporation and the Lancashire Electric Power Co. for a bulk supply, and if this were obtained from St. Helens, the Council was confronted with the possibility of the Lancashire Power Co., disposing of large supplies to people in the town. The Power Co. claimed the right to supply power users in the town.

Mr. J. Scott, chairman of the Bootle Corporation Electricity Committee and a member of the Provisional Committee, said that if the order was made for the establishment of one Joint Authority, it would be absurd to allow the Lancashire Power Co. to supply consumers in Makerfield. If the scheme were carried out, the Authority could give a supply quite as good as any other body. If the supply were given by the Lancashire Co., he thought the load factor would not be to the benefit of the general consumer. He was not in favour of allowing the Lancashire Power Co. to come into the Joint Authority's area, and thus be enabled to pick out their best consumers. If there were two undertakers, there might be doubts as to which of them should develop the area. He thought the Joint Authority could give the most economical supply.

Mr. A. G. Miller, K.C., for the Birkenhead Corporation, said that Birkenhead had always held the view that it would prefer to go on, within the limits of the municipality, developing and extending the electricity undertaking, as likely to give satisfactory results.

Sir John Snell: Not the best?

Mr. Miller, proceeding, said that if the Commissioners disagreed with that, Birkenhead would support the formation of a Wirral Joint Board. A separate Wirral scheme was the best for the present, at least for the Wirral. The Commissioners having embodied the result of the first inquiry in a scheme, he contended that they could not arrive at decisions which entirely altered its nature and character. They could only complete and perfect details of the scheme.

There was considerable argument on this point, when Sir Harry Haward expressed the opinion that the Commissioners had full powers to give what decisions they chose, and it was open to the authorities, if the Commissioners made an order and submitted it to the Minister of Transport, to lodge an objection on the ground that they had no adequate notice at the inquiry.

Mr. Miller remarked that that would be a convenient method of objecting. At the same time, he said the Commissioners should not and could not reverse decisions which were given effect to in the scheme now before them. Wallasey had a first-class station. Why should it be linked up with another station across the natural river Mersey barrier? There was no change in the circumstances on which the Birkenhead and Wallasey claim rested. Furthermore, the Mersey super-station had still to be developed. Birkenhead and Wallasey could get a "cheap and abundant" supply of electricity whether the outside districts came in or not, and developments could conveniently and properly take place in the Wirral, whether or not the larger scheme was found to be practicable.

The inquiry was adjourned until Friday.

On that day it came to an end with dramatic suddenness, when late in the afternoon, Mr. Rowan Harker made a speech defining the position of the Liverpool Corporation. He concluded by quoting a decision of the Liverpool Tramway and Electricity Committee to appoint a committee to consider the draft order, and asked that the Commissioners adjourn the inquiry until the Corporation had determined its attitude. The request was obviously not to the liking of counsel in attendance, but at the same time it was felt that the inquiry could not be continued until the Liverpool Corporation, the most important authority affected by the scheme, had made up its mind.

Mr. Jeeves, K.C., who appeared for the Wallasey Corporation, said that the technical schemes would have to be entirely changed if they had one authority. It had never been suggested by Mr. Wooll or by any of the objectors that they could offer any evidence which would upset the evidence given at the previous inquiry. The only change that had taken place was that two or three local authorities had altered their view. That, he contended, could not have the least effect on the means the Commissioners had determined for providing a "cheap and abundant" supply of electricity. He suggested that it was not right that other districts should be saddled with additional costs because for some local reasons or possibly misrepresentations these authorities, none of which were electrical authorities, had expressed a wish of that kind.

Sir John Snell: At the time of the issue of the notice the Commissioners were not aware of the altered attitude of the local authorities.

Mr. Jeeves, proceeding, said that the Commissioners were bound in the conduct of that inquiry, by the notice they had issued, as to what they should consider. The Commissioners had been asked by Mr. Wooll to reinstate a scheme which they had already said they believed would not be able to give a cheap supply of electricity. He argued that the Commissioners were not entitled, if they did hear objections and did want to accede to them, to do so without further notice of consideration being given to all parties. It had been said that six-sevenths of the Wirral was supporting the Joint Authority, but that area only represented about one-quarter of the population of Birkenhead and Wallasey. Not one authority in the district outside the two boroughs named had an electricity supply with the single exception of Hoylake. The Liverpool Corporation was at the back of the scheme A, and as the Corporation had not got exactly what it wanted it withdrew from the scheme.

After Sir John Snell had reminded Mr. Jeeves that he thought counsel was outside his rights in dealing with the Liverpool Corporation, Mr. Jeeves suggested that the approval or disapproval of the smaller authorities in the Wirral should not be allowed to weigh with the Commissioners. It would be *ultra vires* for the Commissioners to do more than complete the details of their draft; if they wanted to advance a totally new scheme they would have to begin all over again.

Speeches were then made for the Wirral District Council and the local authorities of Bebington, Bromborough, Neston and Parkgate, and Hoylake and West Kirby, and reference was made to the likely future residential and industrial developments of the district. The Wirral Council thought that the cost of transmission mains across the peninsula to the Deeside would be a very heavy burden which could be best borne by the Joint Authority for the district. He believed there were greater hopes of electrical developments at an earlier date with the larger scheme. There were no indications of the Wirral district being able to obtain an immediate supply from Birkenhead or Wallasey.

Mr. Miller said that the Birkenhead Corporation would be pleased to meet any demands for electricity. The arguments of the representatives of other districts were on similar lines to that of counsel for the Wirral Council. The Hoylake Urban District Council supported the Joint Authority, because that was a residential district whose prosperity depended upon the port of Liverpool. It asked the Commissioners to consider what was best for the Merseyside, rather than for Hoylake.

Mr. Stewart Brown then spoke on behalf of the Mersey Dock & Harbour Board. It was essential that the port of Liverpool and the great commercial and industrial districts should be within the jurisdiction of one Joint Electricity Authority. The Board disliked partitioning between two authorities and thought it would be a mistake that the temporary joint board on the Cheshire side of the river should be allowed to develop in opposition to the one on the Lancashire side.

Mr. A. W. Willmer, a member of the Mersey Dock and Harbour Board, and of the Provisional Committee, thought the supply of electricity on the Mersey side required immediate organisation, and the Board was unanimously in favour of one authority only. A committee of the Board had been set up for improving the mechanical appliances on the dock estate, and as old plant was being discarded it was being replaced by electrical plant. A plentiful supply of electricity was required on both sides of the river, because the competition with other ports would be far keener in the future than it had been in the past. Electrical developments were, therefore, an important consideration. They thought it to their advantage to take electricity from the largest authority they could find and preferred to deal with one authority rather than two.

Mr. Jeeves (Wallasey): If the Commissioners are convinced that the present scheme will provide the cheapest supply of electricity, I take it you would deprecate any alteration of the order?

Mr. Willmer: I should say it was the duty of the Commissioners to formulate a scheme giving the cheapest supply. He went on to say that the scheme would be marred if both sides of the river Mersey did not come under the ægis of

one authority. The northern part of the Wirral would develop by leaps and bounds when given better railway facilities. Furthermore, important industrial developments were taking place on the river front, which made it essential for them to have the cheapest supply of electricity possible. He did not think the Wirral Joint Board would be capable of handling such supplies as would be required.

Mr. W. H. Thorne, solicitor to the Dock Board, gave an interesting sidelight on the transfer of the Bootle electricity undertaking to Liverpool. Bootle could not supply the Dock Board at the Liverpool rate, he said, so the Board bought electricity from Liverpool, and brought it through Bootle. Whatever the legal aspects of the question were, it was a business arrangement, and that led to Bootle considering the bigger scheme. If the electricity scheme on the North-East Coast was sound and on the right lines, there could be no question that the Merseyside should have one authority in single control. It was in the interests of the district, for it would have to meet keener competition than ever before.

Mr. W. Newall, the engineer to the Dock Board, said that Liverpool was suffering from the lack of facilities which were in existence on the North-East Coast, and there was a difficulty in getting supplies at all points. The approximate area of the present West Lancs. scheme was about 500 square miles, which was the smallest area that could be fixed with economy. His personal preference was for one scheme for the whole of Lancashire to bring in the whole of the manufacturing districts. About 18 months or two years ago the Dock Board entered into negotiations with Wallasey for a supply of electricity, which was only laid on three or four months ago, in which time the supply was 314,000 kWh. As to a supply from Birkenhead, he could not even get it for his own house.

Mr. Newall said that the Dock Board was taking an increasing supply from Wallasey at a slightly lower cost than from Liverpool, but the greater the usage of Liverpool electricity, the lower the price. On the Liverpool side of the river the Dock Board used about 4,000,000 kWh a year—a total which represented an increase of four or five times compared with five years ago. The Dock Board was developing and was spending £8,000,000 on both sides of the river, but mainly on the Liverpool side. About £1,000,000 of that sum was being spent on the Birkenhead side. The Board's requirements on the Liverpool side during the next ten years would be about 15,000,000 kWh. The Board had plenty of land and plans were laid for the next quarter of a century. The present supply of 1,250,000 kWh on the Cheshire side of the Mersey would probably be doubled within two years and quadrupled in the next ten years.

The Commissioners then heard Mr. R. Harker, on behalf of the Liverpool Corporation. The Corporation, he said, was as anxious as anybody that the supply of electricity should be placed upon the best possible footing, but it, unlike the Provisional Committee, had a big stake in the matter. As trustee for the citizens of Liverpool, of a very valuable and revenue yielding estate, it felt it would be acting contrary to their trust, were it to assent to any scheme without giving it the fullest possible consideration. The Corporation had not yet had the opportunity of considering the proposals in that detail which they deserved. His instructions were to ask the Commissioners to give the Corporation the opportunity it desired. The draft order received towards the end of March contained elements that required the most careful consideration, and the Liverpool Tramway and Electricity Committee applied to the Commissioners for an adjournment, to which they were unable to accede. The Committee then appointed a committee to consider the draft order and to receive reports from the city electrical engineer, and the city treasurer and controller, and to advise the Corporation. That report could not be brought before the City Council before its meeting early in July. The scheme could only be successful if there was voluntary co-operation. If the Corporation were given the opportunity for which it asked it would do everything it could to come to a conclusion.

Mr. Tyldesley Jones, K.C., Mersey Power Co., thought that before the inquiry was resumed, any objections and amendments to the Commissioners' scheme should be presented to the Commission.

Other counsel voiced a similar opinion, so as to avoid the further expenditure of public money.

The Commissioners then adjourned the inquiry until after the July meeting of the Liverpool City Council.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS AND MACHINERY IN APRIL, 1923

The returns of electrical business for the month of April show an improvement in the case of the exports to the extent of £73,000 and an increase in imports of nearly £106,000 as compared with the previous month; as compared with April, 1922, the export figures are £21,801 lower, but the import totals show an increase of £161,858. The principal increased values for the month in the electrical exports occur in the items for electrical machinery (£29,000 increase) and telegraph and telephone material and apparatus (£50,000 increase), whilst a falling off in values is shown in the sections for insulated wires and cables, batteries and accumulators and carbons.

The electrical export totals for the first four months of 1922 and 1923 are:—

	Exports. 1922.	1923.
Electrical goods and apparatus ...	£2,634,534	£2,777,393
Electrical machinery	£1,886,883	£1,327,415
Totals for four months ...	£4,521,417	£4,104,708

During the month of April, 1923, a total of 1,793 tons of electrical machinery was exported, as compared with 1,528 tons in April, 1922, and 1,553 tons in April, 1921.

Electrical imports totals for the month of April were actually £105,702 higher than in the previous month. The figures for electrical goods and apparatus, electrical machinery and telegraph and telephone material for the month show greatly increased values in each section, the electric lamp section being the only one in which a falling off is recorded.

The electrical import figures for the four months of 1922 and 1923 are as follows:—

	Imports. 1922.	1923.
Electrical goods and apparatus ...	£417,192	£701,773
Electrical machinery	£450,512	£384,891
Total	£867,704	£1,086,664

Re-exports of electrical goods, apparatus and machinery for the month totalled £16,586, an increase of £216 on the previous month but a falling off of £19,934 as compared with April, 1922.

	Exports. Electrical exports for April, 1923.	Inc. or dec. as compared with Mar., 1923.	Inc. or dec. as compared with April, 1922.	Imports. Electrical imports for April, 1923.	Inc. or dec. as compared with Mar., 1923.	Inc. or dec. as compared with April, 1922.	Re-Exports. Electrical re-exports for April, 1923.	Inc. or dec. as compared with Mar., 1923.	Inc. or dec. as compared with April, 1922.
Electrical goods and apparatus (unenumerated)	£120,406	+ £8,636	+ £38,260	£86,755	+ £34,387	+ £44,755	£2,827	− £65	− £1,214
Insulated wires and cables ...	160,492	− 15,082	+ 26,994	22,193	+ 5,402	+ 1,725	538	+ 480	+ 522
Glow lamps	29,735	+ 8,940	— 9,443	9,239	− 4,404	− 1,196	547	− 313	− 24,851
Arc lamps and parts	625	− 480	− 330	429	− 1,168	− 969	49	+ 49	+ 49
Batteries and accumulators ...	37,670	− 11,264	− 4,320	10,905	− 686	+ 4,672	1,354	+ 1,354	+ 1,349
Meters and instruments ...	29,585	+ 8,261	+ 1,038	8,085	+ 623	+ 3,402	248	+ 118	− 928
Carbons	1,151	− 6,032	− 1,699	5,753	+ 3,385	+ 4,144	573	+ 508	+ 573
Electrical Machinery—									
Electrical machinery (unenumerated)	121,693	− 12,246	+ 13,908	107,792	+ 25,755	+ 38,825	8,484	− 2,426	+ 5,826
Railway and tramway motors	19,006	− 2,657	− 31,263	—	—	—	—	—	—
Other motors and generators ...	171,000	+ 30,078	− 121,435	—	—	—	—	—	—
Switchboards (not telegraph or telephone) —	18,504	+ 14,570	+ 5,319	1,807	+ 1,767	+ 1,667	—	− 30	—
Telegraph and Telephone Cable and Material—									
Telegraph and telephone wires and cables (not submarine)	100,606	+ 2,130	+ 38,793	10,582	+ 5,905	+ 9,341	—	− 4	− 35
Submarine telegraph and telephone cable	37,128	− 10,153	+ 14,108	—	—	—	—	—	—
Telegraph and telephone instruments and apparatus ...	175,178	+ 58,621	+ 8,269	67,815	+ 34,736	+ 55,492	1,966	+ 545	− 1,225
Totals	£1,022,779	+ £73,322	− £21,801	£331,355	+ £105,702	+ £161,858	£16,586	+ 216	− 19,934

THE FINANCIAL PROSPECTS OF RAILWAY ELECTRIFICATION.

By SIR PHILIP DAWSON, M.P.

(*Abstract of paper read before the* Institute of Transport.)

In 1919 I was instructed by Sir William Forbes, the general manager of the London, Brighton & South Coast Railway, to prepare, for submission to the Ministry of Transport, a report dealing with the economic results which might be expected to accrue from the completion of the electrification of the suburban line services and from the electrification of the main-line services to Brighton, Eastbourne, and Worthing, both passenger and freight.

The conclusions arrived at were so favourable that I was instructed to prepare a further financial report showing the capital expenditure which the proposed electrification would entail and the revenue that would result therefrom; this was completed in the autumn of 1922.

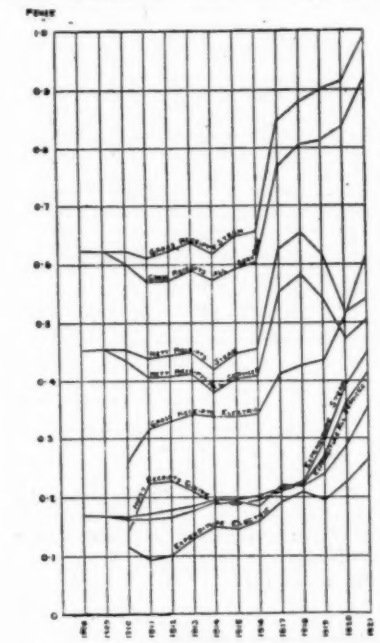

Diagram 1.—Receipts and Expenditure per Passenger-mile.

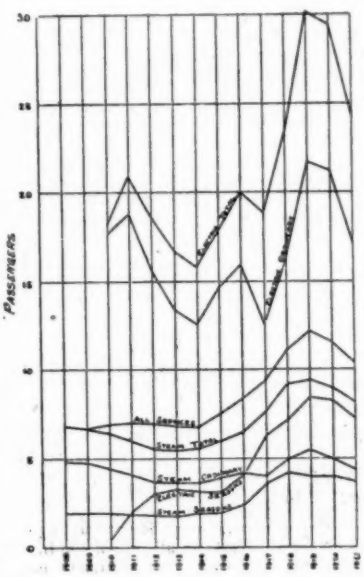

Diagram 2.—Passengers per Train-mile.

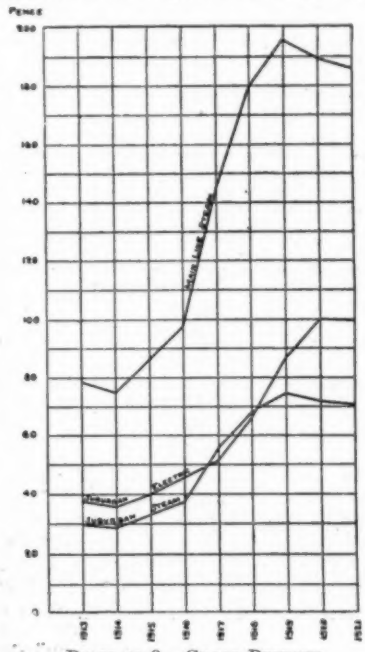

Diagram 3.—Gross Receipts per Train-mile.

The conclusions arrived at, which were carefully checked and confirmed by independent experts called in for that purpose, are of special interest as they are the result of the most complete and thorough investigation, and are based on actual results achieved with steam, and on the results and experience derived from over ten years' operation of electric trains over a portion of the Brighton Railway.

For the purposes of the investigation, the lines to which electric haulage was proposed to be applied were divided into a northern and a southern area, and all charges and train data were apportioned between the areas and the several classes of services affected, a task involving much labour.

As the investigation was carried out to show what benefit might be expected from electrification, only costs such as locomotive costs, train lighting, carriage maintenance and guards, and additional cost of permanent-way maintenance due to increased train mileage, which are the only ones directly affected by the system of traction adopted, were considered and, for the purposes of this investigation, were denoted as "expenditure."

From the net receipts referred to on the diagrams must therefore be deducted all figures which are not directly affected by electric as compared with steam operation, if the net amounts available for dividends are to be ascertained, and the net receipts represent the difference between the gross receipts and these costs only. No account was taken of the increased goods receipts which might be reasonably expected to result.

The electric service on the South London line was inaugurated in November, 1909, whilst the Crystal Palace line has been operated electrically since June, 1911. The 12 diagrams given in the paper show results from 1909 to 1921 inclusive.

It may be useful to consider whether there exists any fair basis on which to compare steam and electric operation for passenger services.

The results arrived at in the course of my investigation seem to prove that the train-mile basis is a much fairer general basis of comparison than might have been expected, although if it were possible to use it, the basis of passenger-seat-miles per hour would in certain cases be more accurate. Seat-miles and car-miles taken alone are both misleading, as, in making any comparison, the average speed has to be taken into consideration.

The following figures will help to clear up this point:—

The average suburban steam train consists of 6.6 coaches accommodating 463 passengers.

The average electric train consists of 4.4 coaches, accommodating 308 passengers.

The average speed of the suburban steam train is 9.31 miles per hour, representing 9.31 x 463 = 4,300 seat-miles per hour.

The average speed of the electric trains would be 21.8 miles per hour, representing 21.8 x 308 = 6,714 seat-miles per hour.

What is required in order effectually to handle any given traffic is to provide seat-miles equivalent to the passenger-miles, and at a varying rate per hour corresponding with the passenger requirements.

With steam trains the seat-miles per day may be greater than with electric trains owing to the longer trains hauled by steam during slack hours of traffic.

The diagrams show that from 1909 to 1920 there has been a steady rise in the number of passengers carried electrically. Steam passengers decreased in number between 1907 and

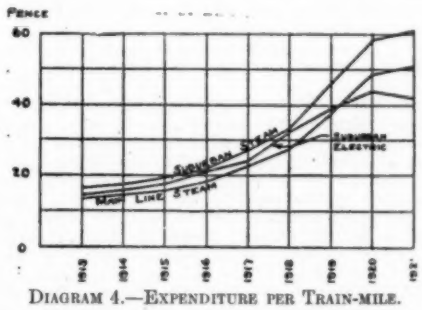

Diagram 4.—Expenditure per Train-mile.

1917, and then rose till 1920, when they only barely exceeded the numbers carried in 1909, and have been falling since much more rapidly than in the case of the electric services.

The gross and net recepts in the case of steam have been falling since 1920, whilst in the case of the electric services they are still increasing. With regard to expenditure in the case of steam it is still on the increase, whilst the gross receipts are diminishing; the reverse is the case with the electric services.

Expenditure per passenger carried has been on the increase

with both steam and electricity, the rise with steam being more rapid than with electricity. The gross receipts with steam have risen from 7.4d. per passenger in 1908 to 14.4d. in 1921, whilst in the case of electricity they have risen from twopence to fourpence.

The gross receipts per car-mile for steam have risen from 7.3d. to 16.5d, or 126 per cent., whilst on the electric lines they have risen from 6.5d. to 21.3d., or 228 per cent. The expenditure with steam has risen from 2d. to 7.8d., an increase of 290 per cent., and with electricity from 3d. to 9d., an increase of 200 per cent.

The comparison becomes still more striking if what have been called for the sake of this investigation "the net results" are compared, and, even if the total expenditure including that unaffected by system were taken into consideration, the ratio between the results obtained with steam and electricity would not be greatly altered.

The net receipts for electricity were £2,800 in 1913; £5,000 in 1519, and £6,500 in 1921. For the suburban steam service they were £1,200 in 1913, £2,100 in 1919, and £660 in 1921, or, in other words, the receipts per annum per mile of track operated were ten times as great with electricity as with

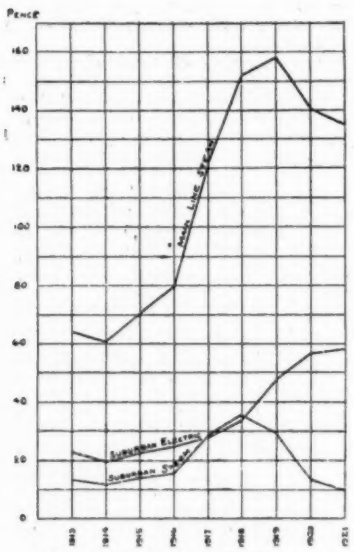

Diagram 5.—Net Receipts per Train-mile.

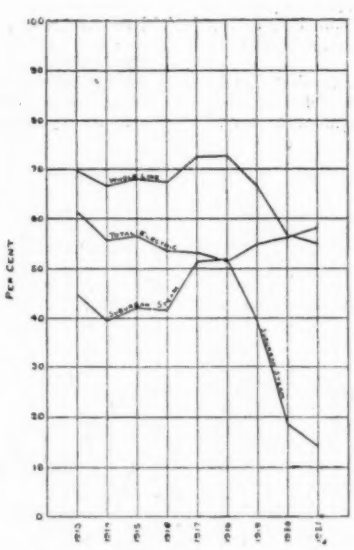

Diagram 6.—Percentage of Net to Gross Receipts. (Operating expenses only.)

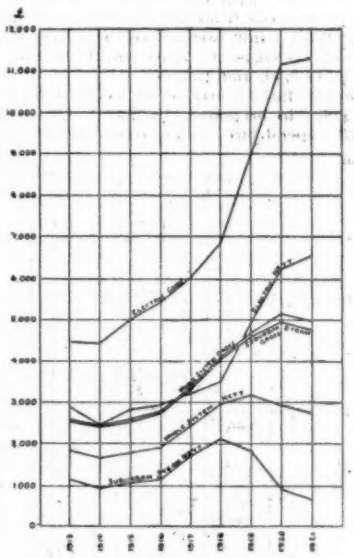

Diagram 7.—Receipts per Mile of Single Track.

The gross receipts per passenger-mile for all steam services have risen from 0.65d. to 0.98d., equal to 51 per cent., whilst in the case of electricity the corresponding figure has been 0.26d. to 0.62d., corresponding to 138 per cent. (diagram 1).

The expenditure per passenger-mile in the case of steam has increased from 0.175d. to 0.45d., equal to 157 per cent., and with electricity from 0.125d. to 0.26d., equal to 108 per cent.

Diagram 2—Passengers per train-mile—shows the better utilisation of the train facilities given with electric as compared with steam haulage. It will be noticed that there is little difference between the utilisation of the main line and suburban steam services. The passengers carried with steam in 1913 were between six and seven per train-mile, reaching a maximum in 1919 of between 11 and 12, and falling to between 9 and 10 in 1921. In the case of the electric services, the passengers carried were between 16 and 17 in 1913, rising to 30 in 1919, and falling to 24.5 in 1921.

The gross receipts per train-mile, diagram 3, of suburban electric services have crept up from 38d. to 100d. per train-mile and were steady in 1921, while in the case of steam the receipts were on the decrease.

As regards the expenses per train-mile, diagram 4, whilst the costs for steam are still on the increase the electric costs are decreasing and are lower now than steam costs. This is due to the eight-hour day, and to high costs of labour and materials.

Diagram 5 shows that the net receipts with electricity are still increasing, while in the case of steam they are on the decrease.

The ratio net receipts to gross receipts, diagram 6, is best for the electric services and is still improving, whilst with steam it has declined steadily since 1918.

Diagram 7 is the most remarkable of all those submitted with this paper. It has been obtained by dividing the total receipts and the net receipts by the miles of single track in service over which passenger trains actually operate, and does not therefore include sidings, goods, or shunting yards. A certain number of suburban steam passenger trains operate over electrified sections. This mileage has not been taken into consideration in these calculations, so that the suburban steam services show up more advantageously than they should.

The whole system, including the electric services, as well as the local and main line steam, is given.

The fact that gross receipts with electricity were still on the increase whereas operating costs were actually decreasing, whilst with steam the contrary was the case, comes out very clearly in this diagram. It is shown that in 1913, the gross receipts per mile of track operated amounted to over £4,500 for the electric services and these had risen to £11,300 in 1921. For the suburban steam service these were £2,600 in 1913, rising to £3,200 in 1919, and falling to £2,800 in 1921.

steam. In this connection it should be reiterated that the electrified zone by no means serves the best areas, and that there are quite as good if not better areas at present served by steam as are dealt with electrically.

(To be concluded.)

CORRESPONDENCE.

Letters received by us **after 5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

A Broadcasting Problem.

The paragraph in your last issue bearing this title is interesting, particularly to wireless enthusiasts. When one considers the conditions, however, it is strange that Mr. Bloomer's experience should be unique, if indeed it is so. We must remember that the two sets were tuned to the same wave-length, and that one of them was a valve set, which, although not operating the recognised reaction coil, was probably reacting to a small degree. The two aerials were close together; the mutual inductance would, therefore, be considerable between the two circuits, which might be regarded as coupled circuits. The lady's voice, acting on her headphone circuit, modulated the carrier oscillations, which were common to the two circuits; and hence the audibility of her remark to her neighbour.

Albert E. Bennett,
A Member of the Croydon Wireless Society.

Anerley, *May 19th*, 1923.

Power Factor.

Referring to the recent correspondence *re* power factor, resulting from Mr. W. E. Rogers's letter, the single-phase unity-power-factor motor referred to is undoubtedly the motor built under Creedy patents and manufactured by Messrs. Parkinson.

We have handled the sale of these machines for the past nine years, and to our knowledge there are some thousands of them in service at the present time in the south of England.

Up to within the past twelve months the Creedy single-phase motor has been the *only* motor on the market which would give unity power factor and leading power factor on light loads, and it is the only motor of this type in general use to date.

Pooley & Austin.

Westminster, *May 16th*, 1923.

Can the "Maximum" Price be Exceeded?

The question raised by "Electricity Supply Engineer" in your issue of May 11th, with your comment thereon, is one on which an authoritative ruling is greatly needed. It is laid down in the Act of 1882 that the charges may be such as *are agreed upon* so long as no undue preference is shown. The old provision under which a consumer charged by a special method could revert to a flat rate after giving one month's notice has been repealed, and there has been no decision as to whether that option would have held good where a definite contract had been entered into for a longer period. Presumably a contract, not *ultra vires*, would have been upheld. At present it seems clear that where the agreed rate is a flat one the maximum cannot be exceeded. But it is in dispute whether a special tariff can be enforced if the total charge divided by the units consumed gives a price per unit in excess of the maximum. This would seem on the face of it absurd. Where a quarterly charge per kilowatt is made, plus a small unit charge, it is surely clear that the former is a method of giving the undertakers that reasonable return to which they are entitled on their capital expenditure; it is not and cannot be made into a unit charge. Thus, if the factory entering into such a contract were closed for the whole quarter by a strike the undertakers would be entitled to their standing charge, but if no units were used none would be paid for. I am told that the Electricity Commissioners have expressed an unofficial opinion on these various points; if so, many of us would be glad to know what it is.

Lex.

May 16th, 1923.

Motor-car Wiring.

I have read the letter from "Inquirer," published in your issue of the 11th inst., and venture to give my opinion as to the most suitable wiring for motor-car equipment.

As far back as 1912-13 the problem received my careful study, and after persistent experiments I concluded that the most suitable cable for the purpose was tough-rubber-covered, popularly known as "C.T.S." My opinions have been maintained, and provided the cable is securely supported to the chassis and dashboard, wiring faults will disappear.

Standard accessories can be readily employed, such as appertain to car-lighting equipment.

W. Ellerd Styles, M.I.E.E.

London, *May 15th*, 1923.

With reference to the letter appearing in your issue of the 11th instant respecting faulty wiring on motor cars, your correspondent "Inquirer" and others will probably be interested to learn that a regular competitor at Brooklands was experiencing continuous trouble with the high-pressure flexible on his car, and upon replacement of the same by "Maconite" flexible cable the trouble entirely disappeared.

We should be pleased to give "Inquirer" or others interested particulars of this cable.

The Macintosh Cable Co., Ltd.

London, *May 18th*, 1923.

Costing.

With reference to the comments of Mr. F. C. Lawrenson, consulting cost accountant, in your issue of May 11th, the writer does not agree. Mr. Lawrenson seems to confuse the issue between production costs and factory costs. There are many charges, it will be admitted, that are not production costs, yet come under the heading of "factory costs."

The item "carriage outwards and packing" on a bulky piece of machinery, being ascertainable, is a direct charge against the job; no matter how this expense is primarily allocated, it is certainly wrong to allocate it even primarily, to office or commercial costs. Would a brewery charge its casks and carriage to office account, or would a firm of distillers charge its bottles, corks, packing cases, &c., to office account? This is analogous to packing. Or again, would an electric supply undertaking charge "carriage on returned empty cable drums" or "cost of making packing cases for machinery parts sent out for repairs" to office account?

The allocation of carriage outwards and packing to office account, either as an overhead charge or a direct charge, is manifestly wrong, and for smaller products this item of expenditure should be charged to factory on-cost.

With regard to Mr. Lawrenson's remarks that "distance goods have to be sent and the type of packing to be used are matters of salesmanship" the writer does not agree. In the first place, the labour and material to make up packing cases, sometimes an appreciable item, and the labour of packing, often skilled, particularly that of a large bulk for shipment abroad, are dealt with by the factory, and what distance has to do with the question of salesmanship the writer fails to see.

It is admitted that in more than one book on costing "carriage outwards" has been included in office expenses, but that does not alter the fact that this is erroneous and is a legacy of the past, and like other statements in a few books relating to costing application, needs rectifying.

Probably if an agreement is arrived at on the definition of "on-costs" it will make the matter clearer. "On-costs," as a term, covers all expenditure apart from capital, but including interest, sinking fund or depreciation, relative to a manufacturing process that does not directly enter into the product, or that cannot be directly allocated to specific items of product, and it will be admitted that there are certain items of expenditure that directly bear on the product, even if they do not enter exactly into it; or, in other words, "on-costs" are the balance of costs over and above prime costs or production costs. "On-costs" are usually divided into factory on-costs and commercial on-costs.

Commercial on-costs include expenses of general office, rents, rates, taxes, insurance, salaries, stationery, stamps, sales expenses, &c. Sales expenses are again sub-divided into publicity, advertising, show-rooms, tendering expenses, travellers' salaries, and other items, but should not include "carriage outwards or packing."

Another Cost Accountant.

May 18th, 1923.

Trading Organisation.

The letter from Mr. W. F. Higgs, which you published in your last issue, is just the old, old story and excuse of the motor manufacturer for keeping the wholesaler as much at arm's length as possible. He frankly admits that he would like to sell direct to the user and pocket all the profits. (And then he talks of selfish combines.)

One of his arguments in favour of this policy is that there isn't a wholesaler in this country to-day who could give a stock order for twenty 10-h.p. motors. Well, Mr. Editor, I do not know what you think of such a sweeping statement, but to me it is absolute nonsense, and shows a profound lack of touch with the genuine wholesaler in the trade. In any case, what encouragement do the motor manufacturers give to the wholesaler to stock motors? They will all sell them to him, but how many will guarantee that they will not quote works and contractors the same price? Very few.

The sooner British motor manufacturers get down off this *special* perch the better it will be for everybody, and the less likelihood will there be of wholesalers looking to foreign markets for motors.

Wholesaler.

May 21st, 1923.

As one of that much-maligned wholesalers' section of the electrical trade, I should like to compliment the E.C.A. for coming out into the open with their suggestions for a trading policy. I am firmly convinced that this manifesto is the work of a group of thinking men who are fully alive to the chaos which reigns supreme, and whose primary motive in publishing it is to get the various sections on the sales side of the electrical industry together round a table to settle their many differences.

If all the other sections, such as the manufacturers, wholesalers, and importers will follow their lead and draw up a trading policy on similar lines to the E.C.A., with the same objects in view, I feel sure that progress will be made towards the desired position.

In the meantime I should deprecate any criticism of the various policies, as, in my opinion, this would defeat our objects. If each section commences to criticise another's policy, either by letters or articles in the Press, then strong language will probably be used, which will inevitably cause bad feeling, as in the past, and as a result the whole scheme may fall through. To use a metaphor, all would be kicking the ball about in an aimless manner, and in the process losing sight of the goal. When these other sections have come into line with their policies the next step should be taken by someone to get them together round one table. Then would be the proper time to discuss any alterations.

In an atmosphere of goodwill and good intentions, with a desire on every one's part to benefit the industry as a whole, even at the expense of a little sacrifice individually, most of our difficulties would, I feel sure, be overcome. Surely the electrical trade is not entirely different to other trades, so much so that it is utterly impossible to follow the example of the M.T.A. and others. I hope not, and for this reason I welcome the facilities offered by the Press to help forward this movement so ably introduced by the E.C.A.

T. Beadle.

Hull, *May 18th*, 1923.

NEW PATENTS APPLIED FOR, 1923.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Patent Agents, 285, High Holborn, London, W.C. 1.

12,174. "Electric switch." B. N. d'Arcy. May 7th.
12,182. "Electric transmission systems." A. M. Taylor. May 7th.
12,185. "Cap for wireless valves, &c." A. E. Maiden. May 7th.
12,217. "Multiple wireless receiver." H. Clifton and H. T. Hall. May 7th.
12,243. "Electric resistance materials." S. Katatani. May 7th. (Japan, May 8th, 1922.)
12,261. "Manufacture of storage-battery separators." H. Wade (Gould Storage Battery Co.). May 7th.
12,262. "Electric, &c., coils and winding machines therefor." H. Wade (Universal Winding Co.). May 7th.
12,268. "Series parallel electric switches." A. K. E. Strathdee. May 7th.
12,269. "Means for registering telephone calls." A. W. G. Scaife. May 7th.
12,284. "Combined handle and coupler for tumbler switches." E. Figueiredo. May 8th.
12,286. "Chains for suspending electric appliances, &c." E. Swingler and G. & J. Swingler, Ltd. May 8th.
12,288. "Electric flash lamp." P. E. Ludlow. May 8th.
12,290. "Thermo electric generator." C. R. H. Bonn. May 8th.
12,303. "Lamps for motor vehicles, &c." F. Hanmer. May 8th.
12,304. "Electric lamps for motor cycles, &c." F. Hanmer. May 8th.
12,305. "Trolley road vehicles." J. S. Highfield and W. E. Highfield. May 8th.
12,313. "Ear pieces of telephones, &c." J. S. Cattell and S. A. Fletcher. May 8th.
12,316. "Automatic switching arrangements for telephone exchanges, &c." J. E. Collyer and Coventry Automatic Telephones, Ltd. May 8th.
12,319. "Rheostats." W. J. Davis and Edison Swan Electric Co., Ltd. May 8th.
12,324. "Electrically-heated steam-pipe oven." H. E. Stedman. May 8th.
12,325. "Device for carrying wireless valves." A. Astley. May 8th.
12,328. "Rectifier crystals for wireless telephony." C. J. Coleman. May 8th.
12,331. "Thermionic valves." W. A. E. Busby and F. C. R. Holland. May 8th.
12,343. "Means for maintaining insulation resistance of electric cables, &c." P. Dunsheath and W. T. Henley's Telegraph Works Co., Ltd. May 8th.
12,356. "Telephonic transmitters and receivers." Ges. für Drahtlose Telegraphie. May 8th. (Germany, August 30th, 1922.)
12,359. "Telegraphic signalling apparatus." F. G. Creed and Creed and Co., Ltd. May 8th.
12,360. "Electric controllers." R. Amberton. May 8th.
12,368. "Electric switches." British Thomson-Houston Co., Ltd. (General Electric Co.). May 8th.
12,377. "Electro-therapeutic apparatus." Ajax, Ltd., C. A. Cooper, and D. F. Sell. May 8th.
12,383. "Liquid tight coating on porous bodies of electrodes, &c." Soc. Anon. Le Carbone. May 8th. (France, June 1st, 1922.)
12,390. "Electric locomotive." T. J. Slater. May 9th.
12,408. "Operating voltage regulator of mercury arc rectifiers." G. Rogers and A. T. Thurman. May 9th.
12,410. "Thermionic valve devices." H. R. S. Johnson and L. Johnson. May 9th.
12,413. "Crystal holders for wireless receiving instruments." A. K. Bindloss. May 9th.
12,427. "Wireless receiving sets." T. Harvey. May 9th.
12,452. "Frame aerials for wireless telegraphy." W. G. Wooding. May 9th.
12,458. "Thermionic valve apparatus." E. A. Graham and W. J. Rickets. May 9th.
12,461. "Automatic electric distributing apparatus." N. Togami. May 9th.
12,467. "Wireless receiving apparatus." E. C. F. Oakley. May 9th.
12,484. "Portable aerials for wireless signalling." H. F. Holworthy. May 9th.
12,489. "Electric dynamos." Soc. l'Electrotechnique. May 9th. (France, May 13th, 1922.)
12,490. "Synchronous induction machines." T. Torda. May 9th.
12,528. "Means for reception, recording, and reproduction of telephonic signals, &c." F. W. V. Fitzgerald. May 10th.
12,530. "Trolley pulleys for electric tramcars." C. E. Whitehead. May 10th.
12,542. "Means for telephonic, &c., transmission, reception, and reproduction of drawings, &c." F. W. V. Fitzgerald. May 10th.
12,543. "Combined valve-holder and filament rheostat for wireless valves." L. B. Watts. May 10th.
12,554. "Boxes of ironclad electric switches, &c." W. L. Barber and Midland Electric Manufacturing Co., Ltd. May 10th.
12,559. "Electric indicator." A. J. Gregory and J. Nicol. May 10th.
12,573. "High-tension distribution systems." J. R. C. August and E. K. Hunter. May 10th.
12,579. "Electric switches." J. W. Cloud. May 10th.
12,591. "Indoor aerial." J. B. Bignamy. May 10th.
12,597. "Installations for electric bells, telephones, &c." H. MacLean. May 10th.
12,602. "Vehicles for rail traction systems." English Electric Co., Ltd. May 10th.
12,603. "Electric devices for control of mechanical movements." English Electric Co., Ltd., and F. Morris. May 10th.
12,607. "Wireless telegraphy, &c." C. A. Keegan. May 10th.
12,615. "Trolley arms, &c., for electric traction." G. B. Canale. May 10th.
12,618. "Electrical apparatus for projection of luminous advertisements." H. L. Vacaresse. May 10th. (France, May 10th, 1922.)
12,623. "Switch devices." R. L. Murray and Telephone Manufacturing Co., Ltd. May 10th.
12,632. "Fittings for electrical apparatus." A. Daniels, H. Daniels, and J. Daniels. May 10th.
12,633. "Connector box for connecting electric wires." A. T. Entwistle. May 11th.
12,636. "Portable electric lighting set for sewing machines." F. Mallinson. May 11th.
12,637. "Programme-controlling device for electric current." A. H. Gledhill. May 11th.
12,644. "Telephone infection preventor." F. J. Phelps. May 11th.
12,655. "Frame for wireless battery." J. M. L. Gysbrechts. May 11th.
12,659. "Mounting electric heating elements." E. O. Johansson, E. R. I. Nordstrom, and H. T. Tillquist. May 11th.
12,667. "Mounting of inductance coils." E. G. Hughes. May 11th.
12,670. "Submarine telegraph signalling." Western Electric Co., Ltd. May 11th. (United States, May 12th, 1922.)
12,671. "Electric discharge devices." Western Electric Co., Ltd. May 11th. (United States, May 12th, 1922.)
12,675. "Telephone, &c., receivers." C. H. Johnson. May 11th.
12,689. "Diaphragm for telephone receivers." J. J. Morch and H. Richmond. May 11th.
12,696. "Selecting switches." Western Electric Co., Ltd. (Western Electric Co., Inc.). May 11th.
12,702. "Rheostats, &c." Igranic Electric Co., Ltd. (Cutler Hammer Manufacturing Co.). May 11th.
12,705. "Electric accumulators." L. Fuller and Fuller's United Electric Works, Ltd. May 11th.
12,715. "Liquid tight coating on porous bodies of electrodes, &c." Soc. Anon. Le Carbone. May 11th. (France, November 3rd, 1922.)
12,716. "Manufacture of stranded conductors or cables." Siemens-Schuckert-Werke Ges. May 11th. (Germany, May 13th, 1922.)
12,723. "Electric generators." J. A. Kuyser, Metropolitan-Vickers Electrical Co., Ltd. May 11th.
12,730. "Automatic telephone systems." T. Lenaghan. May 11th.
12,732. "Control of electric switches." British Thomson-Houston Co., Ltd., and A. S. FitzGerald. May 11th.
12,733. "Contacting devices for dynamo-electric machinery, &c." P. Baxter and W. B. Sayers. May 11th.
12,734. "Incandescent electric lamps, &c." L. S. Vello. May 11th. (France, May 12th, 1922.)
12,739. "Commutator for direct currents of dynamo-electric generators and motors." W. Aldred and T. Millnes. May 12th.
12,763. "Electric welding flux." J. L. Schless. May 12th.
12,766. "Telephone receivers." Western Electric Co., Ltd. May 12th. (United States, November 17th, 1922.)
12,770. "Variometers for radio-telegraphy, &c." J. A. Ward. May 12th.
12,771. "Shunt regulators for electric generators, &c." E. O. Burn and W. Phillips. May 12th.
12,777. "Telephone receivers, &c." British Thomson-Houston Co., Ltd., J. H. Butcher, F. A. Fossey, and A. P. Young. May 12th.
12,778. "Insulating materials." British Thomson-Houston Co., Ltd., and H. W. H. Warren. May 12th.
12,779. "Dynamo-electric machine protective systems." British Thomson-Houston Co., Ltd. May 12th. (United States, June 14th, 1922.)
12,780. "Automatic telephone systems." F. H. W. Dumjohn and Siemens Bros. & Co., Ltd. May 12th.
12,785. "Receiving apparatus for wireless signalling." Electrical Apparatus Co., Ltd. May 12th.
12,790. "Manufacture of tungsten wire, &c." General Electric Co., Ltd. May 12th. (Germany, August 7th, 1922.)
12,803. "Apparatus for short-circuiting rotor windings of dynamos, converters, &c." G. Henderson and Bruce Peebles & Co., Ltd. May 12th.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1921.

28,922. "Alternating-current electric signalling devices." L. J. Rich. October 31st, 1921. (196,639.)
31,369. "Valve-cap sparking plugs." E. Chambers (administratrix of A. Chambers, deceased). August 8th, 1922. (196,642.)
31,641. "Head-lights for motor-cars." G. Kleefeld. November 26th, 1920. (172,028.)
32,309. "Miners' safety lamps." E. A. Hailwood. December 2nd, 1921. (196,647.)

1922.

1,066. "Control of alternating-current electric motors." W. Andrews-Tester and S. Thompson. January 12th, 1922. (196,657.)
1,785. "Electrical switching devices." J. F. Monnot. January 20th, 1922. (196,661.)
2,020. "Telephone mouthpiece dustproof cover." T. P. Howard. January 24th, 1922. (196,668.)
2,109. "Safety car-control and air-brake equipments." British Thomson-Houston Co., Ltd. (General Electric Co.). January 24th, 1922. (196,673.)
2,221. "Vacuum tubes." E. Y. Robinson. January 25th, 1922. (196,678.)
2,394. "Electrical switchgear." D. K. Davies and Metropolitan-Vickers Electrical Co., Ltd. January 26th, 1922. (196,686.)
2,438. "Thermionic valves for wireless telegraphy and telephony." L. G. Preston, H. G. Hughes, and S. R. Mullard. January 26th, 1922. (196,688.)
2,500. "Spark plug." N. H. Russell. January 27th, 1922. (196,691.)
2,536. "Radio-receiving systems." Ges. für Drahtlose Telegraphie. January 31st, 1921. (174,636.)
2,567. "Electrical apparatus used for the production of oxides of nitrogen in the manufacture of flour." F. H. Loring. January 27th, 1922. (196,697.)
2,717. "Electric incandescent lamps." R. Cavedoni and E. Marinelli. January 30th, 1922. (196,701.)
3,433. "Ignition apparatus for internal-combustion engines." A. C. Lock and S. Smith & Sons (Motor Accessories), Ltd. February 6th, 1922. (Cognate application 30,297/22.) (196,715.)
3,512. "Electrical automatic road signal device for cross-roads and road turnings." W. Deacon. February 7th, 1922. (196,719.)
3,561. "Spark plugs." R. Haddan (Corning Glass Works). February 7th, 1922. (196,721.)
3,728. "Commutators for dynamo-electric machines." I. N. Whitesmith, Metropolitan-Vickers Electrical Co., Ltd. February 8th, 1922. (196,726.)
3,868. "Thermo-electric apparatus for heating water and other liquids." V. Ortega. February 9th, 1922. (196,729.)
5,069. "Synchronous dynamo-electric machines." British Thomson-Houston Co., Ltd. (General Electric Co.). February 21st, 1922. (196,750.)
5,400. "Fitments and the like for use in connection with electric wiring systems." F. C. B. Chase. February 23rd, 1922. (196,753.)
7,770. "Electrical switchgear of the 'truck' type or the like." Park Royal Engineering Works, Ltd., and W. J. Davis. March 16th, 1922. (196,775.)
9,178. "System of printing telegraphy convertible at will from line to radio-transmission or the reverse." E. Peruzzi and S. Preti. March 31st, 1921. (177,793.)
9,238. "Collapsible boxes or cartons for packing electric lamps." A. Aviss. March 31st, 1922. (196,783.)
9,353. "Automatic air- and oil-break electric switches." Ferguson, Pailin, Ltd., and G. Pailin. March 31st, 1922. (196,785.)
10,518. "Electric railway tracks with a third or fourth rail conductor." H. Parodi. April 12th, 1922. (196,798.)
11,314. "Electric automatic commutating switches." Anciens Etablissements Barbier, Bénard, et Turenne Soc. Anon. June 10th, 1921. (181,331.)
12,192. "Electric incandescent lamps." H. Lucas and W. H. Eggington. May 1st, 1922. (196,817.)
14,328. "Insulation of electrical conductors." Berrite, Ltd., and F. Fernie. May 20th, 1922. (196,829.)
14,400. "Electric motors for use on alternative electric supply systems." Western Electric Co., Ltd. (Western Electric Co., Inc.). May 22nd, 1922. (196,830.)
15,349. "Electrical outfit for use as a toy or for demonstrations, allowing the realisation of different commercial electro-magnetic machines." M. Latour. June 4th, 1921. (181,020.)
17,165. "Methods of coating glass surfaces." British Thomson-Houston Co., Ltd. (General Electric Co.). June 21st, 1922. (196,843.)
17,814. "Alternating-current power transmission systems." Metropolitan-Vickers Electrical Co., Ltd. June 30th, 1921. (182,478.)
19,021. "Automatic reclosing electric circuit interrupters." Metropolitan-Vickers Electrical Co., Ltd. September 16th, 1921. (186,031.)
20,462. "Dynamo-electric machines." British Thomson-Houston Co., Ltd. (General Electric Co.). July 26th, 1922. (196,848.)
27,294. "Electric winding devices for spring motors." Vox Maschinen Akt. Ges. January 16th, 1922. (191,703.)
30,904. "Methods of and means for receiving telegraphic signals." Marconi's Wireless Telegraph Co., Ltd. November 12th, 1921. (188,670.)